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Is There a Museum Profession?

A. E. PARR, SENIOR SCIENTIST

THE AMERICAN MUSEUM OF NATURAL HISTORY

In the swelling debate about ways and means of improving the performance, status, and rewards of the people who work in museums, the beneficiary of all this tender consideration is commonly referred to quite simply as "the museum profession." It seems to be taken for granted by all concerned that "the museum profession" denotes a very well-understood, if not a clearly defined, reality. The term implies that all who work in museums "at the professional level" are joined in a single profession peculiar to the museums alone. There would be many advantages if these implications were valid. It might help to create a wider sense of solidarity beyond and across the narrower limitations of special group interests both within and between our many and diverse museums. And, if there is a distinct and universal museum profession, membership in that profession would logically become a matter of certifiable record, and special training programs in museum work could be established as requirements for a professional certificate. It is particularly in connection with plans for the training and ultimate licensing of museum workers that one hears the most enthusiastic and uncritical allusions to "the museum profession," as though it were a fact of existence beyond any possibility of dispute. But is this really true, or is it only another case of the wish being father of empty words?

If we are actually entitled to speak of a museum profession, it must mean that there are professional pursuits in which the individual careers are chiefly or entirely confined within the orbit of the museum world, as a person moves from one position to another. The careers of engineers, business administrators, editors, and many others often employed in our museums obviously move in the circles of much wider occupations, and these are presumably not among the occupations one has in mind when speaking of a museum profession. It is plainly among those concerned with education, exhibition, and research that we must look for the pos-

Positions Held Before and After Employment at The American Museum of Natural History during 1939–1959

	Before	After	Total
CURATORIAL STAFF (29 case histories)			
Museum positions	3	1	4
University museum positions	2	1	3
Regular teaching faculty, college and university	18	6	24
Elementary and high school faculties	1	–	1
Research institutions and organizations[1]	9	3	12
Commercial and industrial	4	3	7
Miscellaneous	–	2	2
TOTALS FOR CURATORIAL CASE HISTORIES	37	16	53
EXHIBITION PREPARATORS (34 case histories)			
Curatorial and general museum positions	3	–	3
Museum preparator positions	8	10	18
Commercial preparator (taxidermy, model making, etc.)	8	–	8
Commercial arts and crafts (advertising, etc.)	12	1	13
Skilled industrial crafts	5	–	5
Art teacher, college and university	1	1	2
Art teacher, elementary and high schools	2	2	4
Miscellaneous	2	–	2
TOTALS FOR EXHIBITION PREPARATORS	41	14	55
EXHIBITION DESIGNERS (22 case histories)			
Museum research positions	1	1	2
Museum exhibition preparator	1	1	2
General industrial and commercial design	3	6	9
Commercial art (chiefly advertising)	9	1	10
Miscellaneous	2	–	2
TOTALS FOR EXHIBITION DESIGNERS	16	9	25
TEACHING STAFF (77 case histories, Department of Public Instruction)			
General museum positions	6	3	9
Museum instructors	6	4	10
Teaching, elementary and high schools	24	10	34
Teaching, college and university	1	6	7
Research positions	6	5	11
Social work	4	2	6
Commercial and industrial	5	1	6
Miscellaneous	3	2	5
TOTALS FOR TEACHING STAFF	55	33	88

[1] Other than museums or universities, e.g., government research bureaus, biological stations, aquaria, zoological societies, and so on.

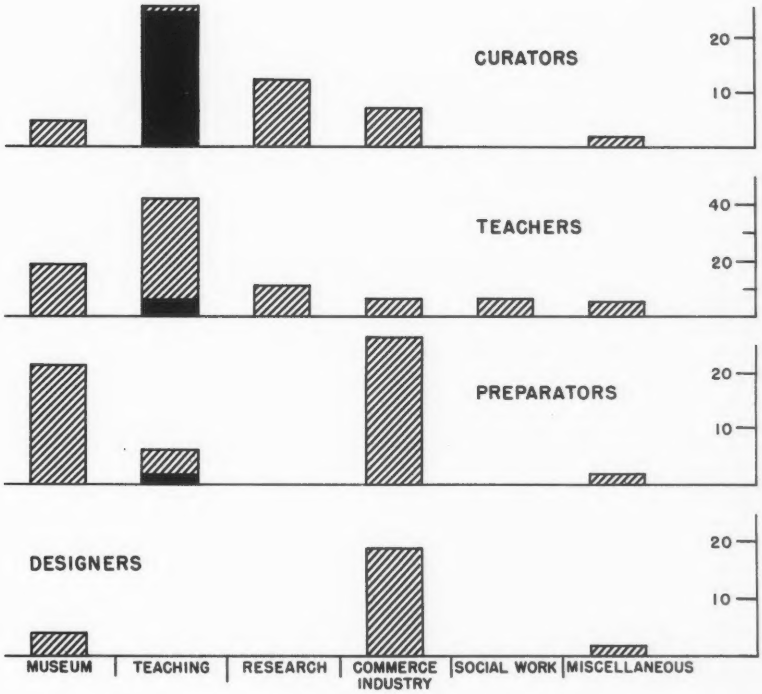

Fig. 1. Positions held before and after employment at The American Museum of Natural History during the period 1939–1959. Teaching positions in colleges and universities are indicated in black, elementary and high school teaching, in lighter shade. Note that the statistics for museum teachers are given on half scale to make the diagrams more directly comparable.

sible existence of a special and separate museum profession. The available information about those who have served these functions at The American Museum of Natural History during the last twenty years, or less, has provided the data for the accompanying table of statistics.

The inquiry has been limited to the last twenty years in order to try to establish the contemporary picture, rather than a composite picture of different historical periods in which curatorial and other careers may have taken different forms. In the case of teachers and preparators, the records of those who have occupied positions at the Museum during the last two decades have been taken into account; in the case of curators and designers, only the data for those who entered or left the Museum's employ during this period. Some data have been eliminated for lack of

adequate information, lack of clear definition of functions, or owing to obvious anomalies (e. g., data for positions that proved to be of a purely transitory nature, alien to the Museum's long-range plans and organization). Also omitted are the data for one designer who reports having spent his earlier career in privacy. In the case of the teaching staff, our information is in almost all cases limited to the last previous, or the first subsequent, position, or both, as the case may be. In the other categories, a good deal more knowledge has been available concerning earlier or later positions that could be included in the tabulation. The statistics shown in the table are summarized by broader categories in the figure.

It is perfectly evident from table and figure that neither the curatorial staff, the teaching staff, nor the exhibition designers at The American Museum of Natural History belong to professions that are in any way peculiar to the museum world.

In regard to the curatorial staff, its members belong to a general academic profession which has its main abode on university and college campuses, with secondary dwelling places in museums and other research organizations. The flow of curatorial personnel is mainly to, from, and between the universities, which account for about half of all the recorded positions elsewhere of those who have also held curatorial appointments at The American Museum of Natural History during the last two decades, with exchanges between museums playing only a very minor role in the picture.

Taking the teaching staff next, we again find the situation dominated by exchanges with outside teaching organizations other than museums, in this case with elementary and high schools making the greatest contribution to the flow, rather than colleges and universities. But the give and take between museums, and with other departments within the same museum, also plays a fairly important, although still minor part. It will be seen that total exchanges within the museums would account for less than one-half of the exchanges between museums and other teaching institutions, which, in turn, provide for nearly one-half of the total flow.

It has already been noted elsewhere[1] that the high degree of specialization in a curator's museum research sometimes will lead to a reduction of his mobility within the wide academic profession to which he belongs. But this does not denote a change of profession, but merely a change of his personal dynamics within the movements of the same profession. For the teaching staff performing the Museum's educational services primarily at elementary and secondary levels, it might be claimed that there is some indication of increased mobility within the general teaching profession as a result of museum service. It is interesting to note that while

[1] CURATOR, vol. 1, no. 1, p. 16.

only one staff member came to the Department of Public Instruction at The American Museum of Natural History from a previous university position, six left the department for appointments to college or university faculties.

Among those directly concerned with the Museum's exhibition activities, it seemed clear in advance that we were dealing with two different categories of personnel, following different careers, although they also have much in common. This assumption was fully confirmed by the figures, when the vital statistics of those who design our exhibitions were tabulated separately from the data for the preparators who create the individual exhibits. While a high mobility in commerce and industry, and a very low propensity for teaching as a full time occupation, seem to be shared by both groups, they differ quite materially in regard to the role of museums in their careers.

According to the table, it would almost seem as though the exhibition designers at the Museum could fairly be described as transient guests from the world of commerce and industry, which accounts for nearly four-fifths of the previously and subsequently held positions. The ratio is probably somewhat exaggerated by the fact that the functions of designers in a museum of natural history are relatively new and therefore still in a state of flux. But, even so, there can be no doubt that exhibition designers as a general rule merely apply to museum problems professional skills that are negotiable assets in a much wider field of human endeavor, and are far more frequently called upon without than within the museums.

This leaves exhibition preparators as the group least far removed from the concept of a separate and distinct museum profession, but, even in their case, industrial and commercial occupations are somewhat more important than other museums both as sources and as destinations for those who have spent part of their professional careers at The American Museum of Natural History. By further breakdown of the general classification of preparator, one could probably isolate a much smaller group that functions mainly within museum circles. Background painters may have a greater mobility outside the museums than do accessory artists, and so on. But such hair-splitting would make it pointless to speak of a museum profession in any event.

Summing up the findings from the facts available, one is therefore justified in saying that, among the many professional occupations at The American Museum of Natural History, there is none that can properly be described as a museum profession. It would have been very desirable to have had more ample data at hand, but the groups we deal with are not large, the rates of turnover in their positions is generally very low, and it would only confuse the issue to dig too far into the past to enrich

the material with records of other eras and other traditions.

What seems to be true of the many professions working in a large museum of natural history is not necessarily equally true for smaller museums and for museums of different kinds and purposes. But the data here presented should, at least, make it incumbent upon those who wish to speak of "the museum profession" to define the terms they use and to demonstrate the existence of a reality in accord with the sense of the words.

Nothing here presented must be construed as an argument against offering more and better training in museum work, nor as an absolute denial that there may be professional occupations that could come under the heading of museum professions in that they are, to all practical purposes, limited to institutions in this category.

We have seen how a large museum employs many different professions that also function widely outside the museum field. A member of the staff of a smaller museum may have to perform many of these diverse tasks himself. A good case could be made for claiming that the combination of many different professional skills in a single individual in itself constitutes the creation of a new profession. But it is an open question whether or not there would be anything to be gained by using definitions that would introduce professional distinctions between staff members of the larger and of the smaller institutions. By itself the idea seems more than slightly offensive, and yet there is a good deal that could be said on both sides of the question.

Consider, for instance, the fact that while a diploma testifying to his training and achievements in general museum work would be a highly desirable asset to one seeking a curatorship in a small institution, the administrator of a large museum who requested similar documentary evidence of qualifications would merely discourage the candidacy of those best suited for the curatorial positions available in his organization. Nor does a university demand of its faculty the pedagogic training and certificates that are of such genuine merit and importance to the teaching profession in our elementary and secondary schools.

Unless we honestly face and acknowledge the fact that the museums function on as many different scales and in as many different ways as do the other educational institutions of our country—each according to its size and purpose—our discussion of professions, training, and diplomas can lead only to confusion and rift. What we need, first of all, are clear definitions of our facts and concepts, and it is hoped that this article may prove a small contribution towards that end.

The Artist and the Museum

CARL NESJAR

BRYN, OSLO, NORWAY

A friend of mine says that there are three places where, when he enters one or another, he immediately starts to yawn. They are churches, cemeteries, and museums. Such a statement, or similar ones, I am sure are not unfamiliar to you; they have been uttered before.

One cannot please everybody, of course, and I am aware that a great many people will yawn as soon as they start listening to matters more serious than advertising patter and light dance music, or reading anything more weighty than comics and photo-magazines.

Broad generalizations do nevertheless occasionally contain some truth, and I think this business of yawning is not a thing at which to snap one's fingers—at least when the subject happens to be museums.

If someone were to ask me in conversation, "What do *you* think about museums?" I would most likely rattle off answers such as these:

Most museums are pompous and tedious and boring, and they have a very special smell of dust.

Most museums cater to specialists and students, and they usually do this in a heavy-handed way.

Most museums fail, inasmuch as they do little to meet the needs of the general public and in many cases even repel the general public.

Most museums are impractical and poorly planned and too full of too many objects badly presented.

Of all museums I think art museums are the stuffiest.

I admit there are some brilliant exceptions, but directors and museum staffs generally show all too little experimental spirit as well as insufficient willingness to meet the public halfway. If the situation were reversed, I imagine official bodies might more easily be persuaded to put more money into the business.

(EDITOR'S NOTE: The present article was delivered as a lecture, on July 7, 1959, to the Fifth General Conference of the International Council of Museums in Stockholm.)

Museums of painting should get rid of or change most of their picture frames, because most of the frames are ludicrous and positively damaging to the effect of the paintings.

Furthermore:

If you are going to a museum you need stamina and a pair of good shoes. I am sure that many visitors would be delighted if they found at the entrance comfortable, silent tricycles which could be rented cheaply by the hour. Walking in a museum, like walking city streets, is very exhausting. (There is the story of an American tourist in an enormous Italian museum: "All this darned art, it just makes your feet hot!" In the film "A Connecticut Yankee," you may remember, Will Rogers introduced modern practices into the life of a great medieval castle; one of them was roller skates for the long corridors and vast halls.) At any rate, tricycles and roller skates apart, there should be plenty of really comfortable chairs or couches in all museums.

Speaking of comfortable chairs, the most pleasant museum I ever visited is the Phillips Memorial Gallery in Washington. It is a private house, converted into an intimate museum. The rooms retain their private-house, lived-in quality. There are carpets on the floors and curtains at the windows, and on the walls there are not too many but very excellent paintings. There are soft chairs and ash trays, and you may smoke if you like, and there are no guards staring suspiciously at you from corners.

All museums not of the Phillips Memorial type should have a number of restful, virtually empty rooms, or porches, or balconies where one can take a seat and from which there is a pleasant view. It is imperative that one be given the chance to relax from the impact of exhibited art or other objects.

All museums should have pleasant, uncluttered, and inexpensive restaurants and perhaps even bars in the French *bistro* style.

Furthermore (I am still answering the question, "What do *you* think about museums?"), museums should be open at least one evening a week.

Music is well served by beautiful surroundings, and concerts should more frequently be given in museums. This would help make museums more of what they should be: *centers of artistic activity.* (I once saw a fabulous performance of Balinese dancing in The American Museum of Natural History in New York.)

Finally:

There are, alas, all too few teachers and experts, so-called, who have the ability to come into real contact with children. In my opinion, it is over-optimistic to think that museums can easily be used as "classrooms." Lectures and guided tours unfortunately tend to raise an insurmountable wall between the exhibits and the spectators (be they adults or children) rather than to facilitate contact.

Now, if I were to try to define what I think are the essential function and the goal of museums, I should stress two points: First, museums should help men and women to see where they stand in time and place, that is to say, in the evolution of mankind. Second, museums should be places where art and other products of the human hand and spirit may be seen in a setting which enhances their beauty and power and so enables them to stir the emotions of men and women, transporting them for a little while out their humdrum every-day existence.

Taking stock of the situation at present, I find that the general run of visitors to museums resemble nothing so much as despondent fish, swimming listlessly and empty-eyed from one picture to another, from one object to another. There is a combination of aimlessness and acquisitiveness. We live in a society which maintains that you must try to grab as much as possible as quickly as possible.

I began by venturing the personal opinion that most museums are pompous and tedious and boring. Let me try to explain what I think is a bad museum and what I think is a good one.

The most confusing museum I have ever seen is the British Museum. A few years ago I chanced to see in a photographic magazine a superb photograph of a certain piece of African negro sculpture. Later I found that this piece belonged to the British Museum, so on my first visit to London I went expectantly to the Museum to find it. I had the feeling that I was rummaging in an enormous attic, except for the deplorable fact that I could not touch anything. It took some doing, but I finally found what I was looking for. My beautiful African sculpture was literally half hidden away in an overcrowded glass case, and it was frustrating not to be able to see it properly. What a treatment of a beautiful work of art! I hate glass cases.

My first very strong emotional experience of this piece of sculpture came to me by way of the photograph, and having seen or, rather, having tried to see the original in the Museum, I now cherish the photograph more than ever.

There will never be money forthcoming to enlarge the British Museum ten times, I suppose. The logical course, in my opinion, would be to leave it the way it is but to close it to the public. One would then have a warehouse for the benefit of specialists. But one would have to find a house next door, or close at hand, in which to show a few choice things. That would release their potential emotional power. As things are now, the power and beauty of these objects are suppressed by the Museum. Incidentally, one thing that I find very irritating is the way in which the appearance of exhibited objects, such as African sculpture, is marred by catalogue numbers prominently placed; such markings should be hidden away as much as possible.

The opposite of the warehouse type of museum would be a well-laid out, spacious, inviting place—a place of spiritual exaltation.

Somewhere in between the attic or warehouse and the spacious modern system one can find certain attempts in the way of sorting out accepted masterpieces for special display, but such selection is a kind of hero worship. Very often, I think, it misses the mark. I find it very disagreeable, for example, to read a book in which someone else has underlined certain passages and cluttered the margins with exclamation marks and jottings. It gives me an uncomfortable feeling that a schoolmaster or some similar despicable authoritarian is breathing down my neck and pointing out to me what is good and bad. This makes independent thinking and feeling very difficult. Indeed it makes it very difficult to think or feel anything at all. I had this uncomfortable feeling in the room containing Rembrandt's so-called "Night Watch" in Amsterdam. In one respect it was like going to the cinema or the theater. The painting was literally in the limelight. But certainly paintings have nothing to do with films, plays, or floor shows. Also, I detest being literally forced to take a certain position and being forced to admire a certain work in a fashion which is considered right and proper.

The "Night Watch," you will remember, was relieved of its many layers of varnish some years ago and took on the appearance which it presumably had when Rembrandt painted it. This operation naturally caused an uproar of protests from all those who love to see things through varnish. To my mind, however, the museum went only halfway. I am glad the varnish is off the picture, but I have a definite feeling that the atmosphere of the room in which it hangs is, so to speak, covered with varnish.

A different example of the hero-worship technique is the "Mona Lisa" in the Louvre. In its very plush setting, now even protected by a semicircular railing, it is always surrounded by whispering tourists obeying orders to admire the best, thinking that they feel what they should feel in the presence of "great art." I dare say there are better paintings in the same room and within a few yards of the "Mona Lisa."

It is easier, of course, to criticize than to make positive suggestions, let alone find proper solutions. I shall try to explain what to me would seem better ways of showing art or, rather, of making it accessible—giving art the possibility to provoke free *emotional reaction.* For that, I think, is the *raison d'être* of art.

Modern society being what it is and modern people being what they are—distracted, harried, and hurried individuals—I would suggest that if you want people to find their way to museums make displays that will, if necessary, shock them out of their little private worlds, but do not tell them what to feel or think.

First, because museums tend to daze any visitor by the sheer weight and number of objects presented, I would begin by thinking over the psychological implications involved and then perhaps try a "surprise technique" of showing only two or three objects, perhaps even only a single one, per room. Such would not be a permanent arrangement; museums should at any rate be in a constant state of slow change.

There is much to be said for the one-object-a-room approach.

In the city of Perpignan in the south of France there is a small chapel next to the cathedral. In the chapel there is a superb sculpture in wood, of the fifteenth century if I remember rightly, of Christ on the cross. The chapel itself is nearly empty and has no other decoration or embellishment. The effect is striking and is in part due, I am sure, to the fact that the sculpture works its spell alone. The visitor, or religious believer, as the case may be, is not distracted by other objects.

There is something very appealing about the Japanese way of hanging only one picture at a time, and I think this method might be allowed to influence the techniques of modern museums.

The Art Institute in Chicago, I recall, used to display a "Picture of the Month." Maybe this practice is being continued. I am sure that many visitors had a real experience of the "Picture of the Month" if of nothing else in that museum.

All artists know that the appearance and effect of a picture may be changed radically simply by its being shifted in position, moved from one wall to another, hung high instead of low, or seen at one distance or at another. The effect of merely a change of lighting or of the angle of vision often seems almost miraculous. For this reason I believe that paintings and sculpture in museums should constantly be rearranged. All objects take on a certain character as a result of the influence exerted by their surroundings. You may have a favorite picture in a museum. But if it were moved to another place, or if the surroundings were changed, the effect of the picture might change very much indeed. It might even lose its spell; you might find that the *surrounding* pictures had really held your interest all the while without your being aware of it. Easel paintings are not meant to be seen in any one particular light anyway, no more than poems are meant to be read only at twilight.

If you decide to take the risk of rearranging your pictures or objects, and the result is not quite so good as you expected, you can always change back to the old arrangement.

Another pet idea of mine is what might be called the mixing or juxtaposition method.

During the German occupation of Norway, painting classes of the Academy in Oslo were conducted for a while in a large private studio belonging to one of the professors who at that time happened to be in

a forced labor camp. Suddenly one day two men turned up, gingerly carrying a large flat parcel. One of them was a well-known elderly painter, the other an art collector. They carefully removed the string and paper and cardboard, and, lo and behold, propped up on the model's stand and surrounded by our clumsy nude studies stood a Cezanne masterpiece, "The Women and the Tent." The impact of the picture in these surroundings was tremendous, breathtaking. It is an emotional experience I shall never forget.

I had a similar experience about a year ago. There is in Oslo a private organization called "Friends of the National Gallery," members of which contribute money for the purchase of works of art to be presented to the Museum. Last winter the organization ventured to buy some contemporary art of the Paris school, including works by Poliakof, Corneille, and Bissière. In connection with a formal presentation of the paintings to the Museum a meeting was arranged. An art historian gave a lecture on the painters whose work had been purchased. The lecture was given in a room devoted chiefly to Dutch and Flemish art of the sixteenth and seventeenth centuries. The École de Paris paintings were mounted on easels, and during the lecture colored slides were projected on a screen. To see the modern pictures, and the slide projections as well, next to the Low Country paintings of another age was, as the Americans say, a real "eye-opener." It was fascinating!

I had a similar experience in Paris last June when I visited the exhibition "13 Peintres Espagnols Actuels" at the Pavillon de Marsan in the Musée des Arts Décoratifs. To reach the Spanish show, one had to pass through rooms full of cameos, furniture, paintings, watercolors, and bric-a-brac of the nineteenth century. After such a typical little museum promenade, the effect of the Spanish paintings was like an explosion.

Things often gain in power through contrast, and for this reason I would like to see the juxtaposition method (or call it what you will) used in museums.

Just to find out what happens, put together in one room, for instance, a Stone Age and a Bronze Age engraving, a Coptic portrait, a Dürer, a Rembrandt, a Corot, a Dali, a Picasso, a Vasarely, a Jackson Pollock, and maybe an excellent photograph or two for good measure. This technique is related to montage in film. The possibilities of variety and revealing combinations are endless.

A new museum that has been receiving a fair amount of publicity lately is the Louisiana near Copenhagen. This new museum seems to be something between the Phillips Memorial in Washington and, say, the National Museum of Stockholm. The Louisiana is not a private house turned into a museum, nor, on the other hand, a castle or a fortress masquerading as a museum. It is a small and apparently very handsome building con-

structed for the purpose. In this case a museum has, so to speak, been cut down to size to fit the human scale. Boisterous Danish burghers, I hear, land in the beer garden as soon as they have done with the collection, and over a tankard or two of beer they jubilantly denounce modern art. That is very good. It shows a reaction. They have been impressed by what they have seen. Pictures and sculptures, if denounced or poked fun at, are not dead.

It may be questioned whether the contemporary trend of "open" structures is right for museums. Great glass walls which pull the surroundings into the building will easily become a disturbing element. Also, there is a great deal of easel painting and sculpture which does not have the kind of power or even the size to compete with grand views of bustling city streets or trees or fields. I think most painting and a fair amount of sculpture are shown to best advantage in closed rooms. However, as I mentioned in the beginning, there must be intervals of relaxation. In the Louvre, which is not exactly what I would call the ideal museum (although it has a flavor all its own), I enjoy the possibilities of a pause provided by the French doors which one comes upon once in a while; they afford a view of the Court or the Tuileries or the river, and one escapes for a moment from the impact of the art.

If we consider the relative merits of, say, the Phillips Memorial Gallery, the Louisiana, and the Louvre as buildings in which to display art, we are faced with the question of just what is the ideal room for purposes of display.

I think there is one important point to be made here. Besides being practical and functional, the rooms must have the simplicity, the unobtrusiveness, the weight, and the dignity required to bring out the best qualities of the painting and sculpture. By this I mean to say that it does not suffice for rooms to be modern and tasteful; they must be good enough, architecturally speaking, so as not to fall into the category of "period pieces" in a few years' time.

Nearly a year ago an article appeared in *Paris-Match* about Picasso in his new surroundings at the chateau of Vauvenargues in Provence. I was especially struck by one of the photographs in the article: Picasso sitting alone in an empty Renaissance hall looking at three or four of his fresh paintings standing on easels. There was a beautiful interplay between Picasso's dynamic canvases and the simple dignity of the Renaissance room. It was a clear case of one style's enhancing the effect of the other. I think the rooms of modern museums must have this simple, almost timeless dignity.

You may think I am overstressing the point in this matter of beautiful and striking presentation in order to establish contact between exhibits and the public. But I believe that, as the church no longer can be said

to be the focal point of society, some form of spiritual and cultural center should take its place, or fill at least part of the vacancy.

The Museum of Modern Art in New York is, I think, a step in the right direction. When I was living in New York years ago on a bare subsistence, I always looked forward to a Saturday morning at the Modern Museum. There were good films to be seen at a very cheap price, and there were frequent exhibits presented in such a way as to be real "eye-openers." Even if you didn't have the money to buy a drink in the restaurant it was always pleasant to sit for a while in the garden.

There is much talk about the integration of art and architecture. As concerns museums, I wish there were more talk of the integration of the arts, or even of the arts and sciences. We live in one world, and all things are related.

It might be fun if museums of natural history, technological museums, and museums of art, music, science, applied arts, folk art, the theater all got together once in a while to put on *combined exhibits.*

I am sure many things would be thrown into sharp relief if, within a given frame of reference, you made an exhibition comprising, say, an African culture—a Benin bronze with costumes, drums and other musical instruments, implements, and weapons, in connection with, for instance, a Rodin sculpture accompanied by Impressionist paintings and some costumes, weapons, mechanical constructions, and scientific inventions of the period. Finally, add such products of our time as sculpture by Brancusi, Pevsner, Giacometti, or Germaine Richier, paintings by Picasso, Hartung, and Jackson Pollock, modern clothes, a microscope, a sports car, an atomic warhead for a rocket, a photograph of Hiroshima after the bomb, and designs for space-ships. Music, ballet, and the film could also be fitted into such a scheme.

Time and time again I meet people (including artists) who, strangely enough, *fail to see the connection between art and life, of which art is an expression.* Surely many of them would see and understand, if this were only pointed out to them in a clear and forceful way.

There seems to be a general need for orientation in our time. Everyone is overwhelmed by the weight and number of things which demand attention in a world the distances of which are diminishing every day. Art plays a prominent role in any attempt at orientation. Should not this be a central field of work for museums?

Anyone searching for a clue, an orientation, be his search ever so vague, is bound to pick up something on the way. To twist the biblical phrase: Whosoever seeketh, findeth—something else.

I must point out that I am not a "culture-optimist." I do not believe that everything can be taught in ten easy lessons. I do not share the popular idea that all things can be "popularized" and "spread" to the

vast general public. A Dane once remarked, "All this talk about spreading culture—as if it weren't spread (thinly) enough already!"

There is another point worth considering in connection with museums of art.

Quite a few intelligent people maintain that our art museums, as well as the modern sculpture and easel or "cabinet" painting housed in them, are all part of an *obsolete* tradition.

Herbert Read in his book "The Philosophy of Modern Art" takes a drastic view of the situation. In a chapter called "The Fate of Modern Painting" he writes, ". . . the cabinet picture has lost, or is quickly losing all economic and social justification, and to try to keep it alive by State patronage is like trying to keep a dodo alive in a zoo. Indeed, there is more than a fanciful parallel between the museum and the zoo; they are both places where we keep rare and eccentric specimens at public expense. And why not, to be logical, put the artist himself in the zoo: let him have a comfortable cage with a northern light, and there let him produce obsolete art objects to be hung in an aquarium-like building next door."

I am rather inclined to share Herbert Read's view that the economic and social basis for cabinet art is weakening. No one can be sure whether this form of art will be with us for good. But I do nevertheless believe that museums are or, rather, can be indispensable mirrors held up to society, rather than storehouses of obsolete art.

Cabinet painting as a profession, a means to a livelihood, will perhaps gradually disappear. In that case the fine arts will find other modes of expression. Picasso a couple of years ago toyed with the idea of housing people in buildings shaped like sculpture or, rather, housing people in a form of sculpture. There are other possibilities: have no cabinet art in private homes, but outdoor murals and sculpture on a grand scale, and so on. In any case the urge to express oneself in graphic and plastic form will surely never disappear. But art museums of *contemporary* art may gradually vanish from the scene. Certainly, if the economic basis for the purchase of art for private homes gradually is lost, no artist in his senses will count on state museums springing up in great numbers to support him and thousands of his colleagues by purchasing their work and preserving it. State patronage is not to be depended upon, in any sense of the word. State patronage must needs be collective and ideological, and it must try to please everybody. Also, it cannot afford to take risks.

A major difficulty, for large as well as small art museums, is the purchase of contemporary art. Gifted and clear-sighted directors, not to mention such collective monstrosities as purchasing committees, are just as rare as gifted and clear-sighted artists.

In the Stockholm Museum of Modern Art there was an interesting

exhibition with the theme "Pictures which have aroused interest and caused controversy during the past year." A show of this kind gives the public an opportunity to see a considerable number of contemporary pictures under the roof of a public museum, even if the museum does not own the paintings. And the artists, mostly young people, have the pleasure of seeing their own work in a museum.

The head of the Louisiana in Denmark, I understand, discusses possible purchases with the artist in question, in an effort to buy only those paintings that the artists themselves would prefer to be seen by a large public. (I have seen many instances of a museum's buying a painting that the artist himself did not consider his best work.)

One characteristic of our culture which in the future perhaps will be looked upon as very curious is our idea that works of art have permanent value. In many societies of the past objects of art were regarded as having only transitory value. Temples and churches and stately buildings were periodically torn down and rebuilt, murals were covered over and repainted, without anyone's having any qualms about the destruction of the old. In our time we may have some underlying fear that the old is more valuable than that which we are capable of creating ourselves.

Whatever the future of museums, and particularly museums of art, I am convinced that they have an important place to fill in our lives. To do this they must not be set apart from a living tradition.

Clive Bell, in a book called "Art," first published in 1914, has some things to say about museums and their place in society. He is very much concerned about museums in relation to children. After all, the child is father to the man, and the children of today are the ones who will, or will not, appreciate, support, or even create art tomorrow. In a chapter called "Society and Art," Clive Bell writes: "Can we by any means thwart the parents, the teachers and the systems of education that turn children into modern men and women? Can we save the artist that is in every child? At least we can offer some practical advice. Do not tamper with that direct emotional reaction to things which is the genius of children. Do not destroy their sense of reality by teaching them to manipulate labels. Do not imagine that adults must be the best judges of what is good and what matters. Don't be such an ass as to suppose that what excites uncle is more exciting than what excites Tommy. Don't suppose that a ton of experience is worth a flash of insight, and don't forget that a knowledge of life can help no one to an understanding of art. Therefore do not educate children to be anything or feel anything; put them in the way of finding out what they want and what they are. So much in general. In particular I would say, 'do not take children to galleries and museums.'"

In another part of the same chapter he says, " . . . it is so hard to feel

a genuine personal emotion for what one has been brought up to admire."

Clive Bell's admonition "do not take children to galleries and museums" is, I think, too categorical. Some museums, if not all, have changed for the better since 1914. I would rather say: "At first take children to museums just to make them aware that such places exist."

In ending, I should like to quote a few more sentences from the same chapter of Clive Bell's book: "Ninety-nine out of every hundred people who visit picture galleries need to be delivered from that 'museum atmosphere' which envelopes works of art and asphyxiates beholders. They, the ninety-nine, should be encouraged to approach works of art courageously and to judge them on their merits. Often they are more sensitive to form and colour than they suppose. . . . In dealing with objects that are not expected to imitate natural forms or to resemble standard masterpieces they give free rein to their native sensibility. It is only in the presence of a catalogue that complete inhibition sets in. Traditional reverence is what lies heaviest on spectators and creators, and museums are too apt to become conventicles of tradition."

Society can do something for itself and for art by blowing out of the museums and galleries the dust of erudition and the stale incense of hero worship. Let us try to remember that art is not something to be come at by dint of study; let us try to think of it as something to be enjoyed as one enjoys being in love. The first thing to be done is to free the esthetic emotions from the tyranny of erudition. The museums and galleries terrify us. We are crushed by the tacit admonition frowned from every corner that these treasures are displayed for study and improvement, but by no means to provoke emotion. Can we induce the multitude to seek in art not edification, but exaltation? If we can do this, we shall have freed works of art from the museum atmosphere, and this is just what we have got to do.

Animated Exhibits with Acrylic Materials

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Polymethyl Methacrylate has found increasing application in museum work since supplies became generally available following the end of World War II. It can be safely assumed that many preparators have used this versatile synthetic resin in one form or another and already possess a good working knowledge of cast acrylic, better known by such trade names as Lucite, Perspex, or Plexiglas.

It would be superfluous to devote space in the present article to information generally known or available for the asking. The principal manufacturers of cast acrylic have, over the past eighteen years, published indispensable data in magazine articles, technical bulletins, and books.[1] These include useful information in regard to the optical properties of the material and applications of edge-lighting in industry and in the design of illuminated displays. (For an example of such use, see "Exhibit in Progress" by Harry L. Shapiro, CURATOR, 1959, vol. II, no. 3, pp. 236–251.)

The main purpose of this article is to discuss the use of cast sheet acrylic in animated exhibits. For a better understanding of the factors involved, it will be necessary to make brief reference to relevant data already known or published. Supplementary information will also be provided in regard to the handling and working of the material in sheet form.

I

Light transmission in a dense optical medium surrounded by air is subject to principles which have been well known for centuries. In 1915 a United States patent was granted for an illuminated sign making use of

[1] Technical information is currently available free on application to the two principal manufacturers of cast sheet acrylic (Imperial Chemical Industries, Ltd.; and Rohm and Haas Company). A bibliography is appended at the end of the present article.

these principles.[2] Edge-lighting signs in sandblasted glass have since been fairly common. However, until the appearance of acrylic resins and cast sheet acrylic, edge-lighting had rather limited applications.

The behavior of light in acrylic plastics has been described by Pearson,[3] Blumenfeld and Jones,[4] and, in less detail, in the trade publications to which reference has been made above. Briefly, a beam of light parallel to the surface of a sheet of acrylic of uniform thickness is, on entry through one edge, first refracted, then reflected, from one polished surface to another (Fig. 1). If the surfaces are clean, free from scratches or defects, approximately ninety-two per cent of the light entering the material will thus be transmitted by internal reflection to the opposite edge. If parts of the reflecting surfaces of the sheet are disturbed by abrasion or merely excluded from contact with air, the efficiency of light transmission will be reduced and the material will "leak" light at the points thus treated. It follows therefore that a planned design worked into a sheet by a variety of methods, such as dry-point etching, engraving, abrading, sandblasting, carving, silk-screening, printing, or painting, can

[2] United States Patent No. 1,146,361 of July 13, 1915, entitled "Illuminated Sign" granted to W. H. Spence and H. C. Storm.

[3] Henry Pearson, "Piping Light with Acrylic Materials," *Modern Plastics*, August, 1946, pp. 123–127. A photostatic copy of this article and others in *Modern Plastics* can be obtained at moderate cost on application to: *Modern Plastics*, 575 Madison Avenue, New York 22, New York.

[4] Alfred M. Blumenfeld and Stanley E. Jones, "Light Behavior and Transparent Plastics," *Modern Plastics*, Encyclopedia issue for 1959, pp. 27–29.

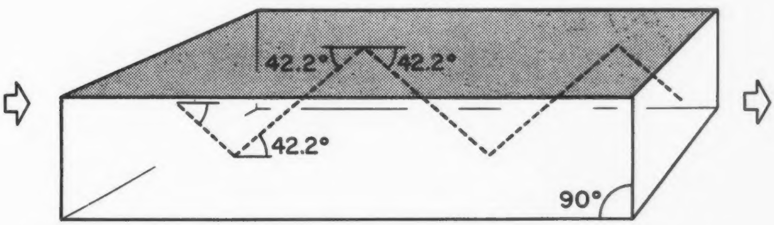

Fig. 1. Path of light in acrylic sheet. Given that the sheet is of uniform thickness and surrounded by air, a beam of light in a sheet of acrylic cannot escape if it hits an outer surface in contact with air at an angle greater than 42.2 degrees, known as the critical angle for an acrylic-air boundary. This allows quite a wide beam of light to be accepted into the material and transmitted to the edge opposite, even if the sheet is curved. In any application in which it is required to pipe light around a corner, the radius of curvature should be over three times the thickness of the sheet.

be made to glow while the background remains dark.

A little experiment will soon convince the enthusiastic initiate that there are many possibilities to be exploited in this medium. In theory it would appear to be a simple matter to execute a design on one or several sheets of acrylic and provide edge-lighting. In practice there are several complicating factors. Some of these are related to the equipment required in the working of the material; others, to the physical properties of the material itself. Finally, the laws of light refraction and reflection provide limitations which must be observed.

Although painting and dry-point etching can be made to produce good results, sheet acrylic cannot be economically worked to its best advantage with conventional hand tools. Even in preliminary experiments, it is almost essential to have at least one power tool with some method of speed control, either a flexible shaft with a hand piece or a light, high-speed, hand grinder. In due course more powerful tools

Fig. 2. A simple frame with adjustable edge-light for working sheet acrylic. The frame is hinged to a table top at H. The supports SS allow the frame to be clamped at any convenient working angle. The upper edges of side pieces SP and lip on adjustable stop AS are rabbeted to accommodate half-inch, sponge-rubber strips, SRS. For greater protection, especially if the original masking paper is entirely removed, these strips could be covered with loose lengths of flannel two inches in width which can be changed as required. The sheet to be worked (not shown) is placed on strips SRS, the lower edge resting on adjustable stop AS clamped at the point required by means of wing nuts WAS. The adjustable strip light, ASL, is moved down to meet upper edge of material on frame and clamped in position by means of wing nuts WASL. The strip light L of ASL may be moved up or down by means of wing nuts WL and tightened at the point where lamp L is in line with the upper edge of the material. The visor, V, covers strip light L, and its free end, protected by sponge rubber, rests on upper surface of material to be worked. A movable mirror, M, may be used for checking the work in progress without removing the sheet.

Fig. 3. A larger work frame. In the arrangement shown, two small frames are in working position. To accommodate sheets larger than three by four feet and up to nine by twelve feet, these small frames can be pushed back to allow a larger frame (not shown) to be bolted to the vertical supports. The shelf shown in the middle is then turned over and clamped to the lower part of the frame to provide support for the sheet to be worked. The smaller work frame on the right is shown with an acrylic sheet edge-lighted from the movable fixture above. The control above the light to the left provides speed variation in the tools plugged into the upper line of power outlets. By means of an adjustable clamp, the nozzle of the air hose at the left can be directed to blow chips away from the work in progress.

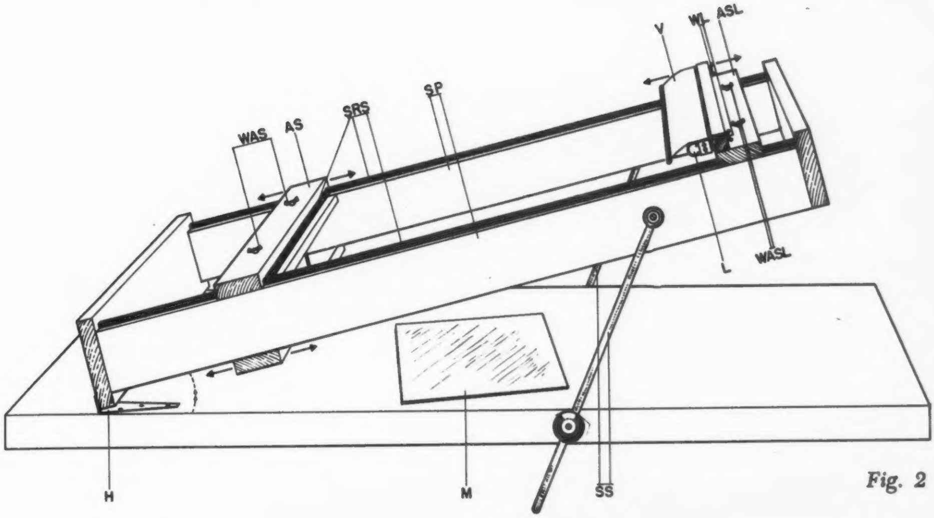

Fig. 2

Fig. 3

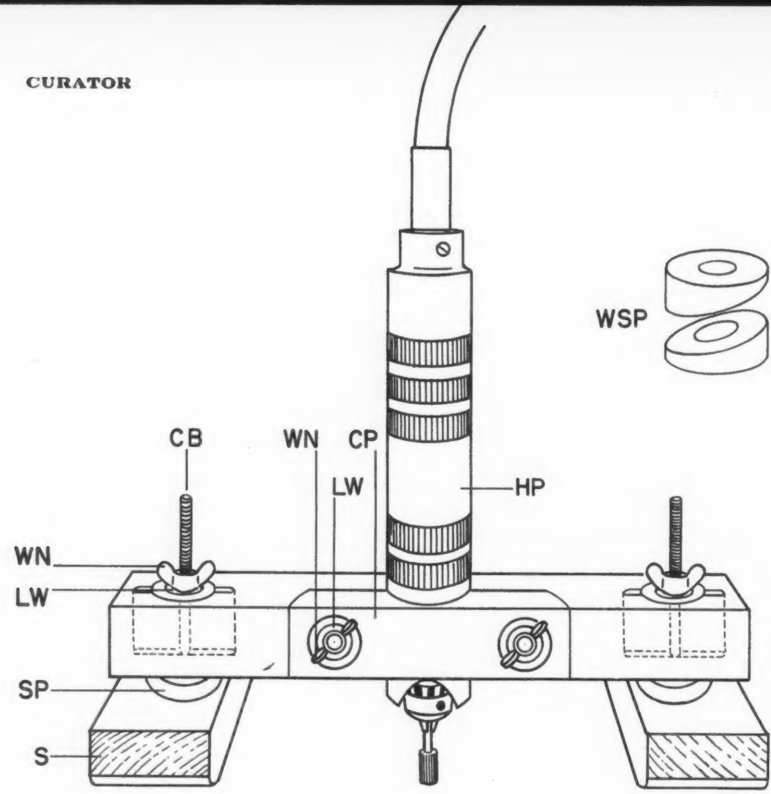

Fig. 4

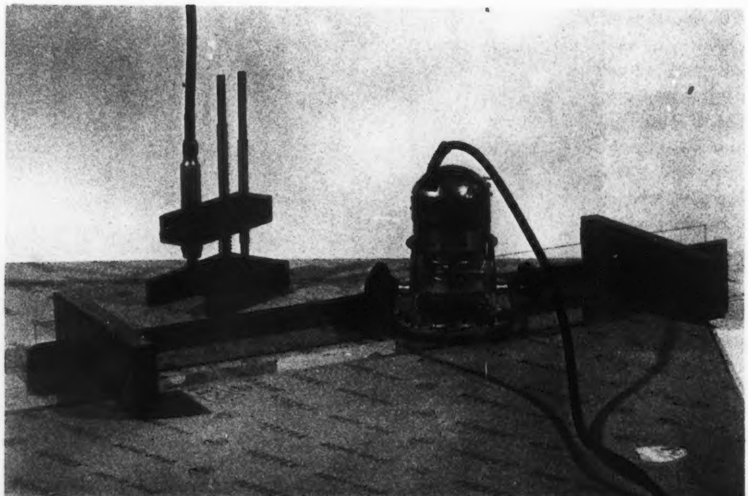

Fig. 5

will be required with chuck capacities up to one-quarter of an inch and capable of speeds of around 45,000 r.p.m. for the efficient use of carbide-tipped cutters.[5] All these power tools make noises which increase with the size of the cutter, the speed employed, and the pressure applied.

Some form of eye protection must be provided against broken or

[5] See Rohm and Haas Company Bulletin No. 15e, "Sources of Supplies," page 5, under "Internal Carving and Engraving Equipment"; also page 7 in the same Bulletin under "Router Bits" and "Routing Equipment."

Fig. 4. Hardwood routing attachment with depth gauge for flexible-shaft hand piece. This useful accessory can be adapted to accommodate any type of flexible-shaft hand piece or light hand grinder. The hand piece, HP, can be tightened at any convenient height by means of wing nuts WN. The small spacers, SP, are optional and need not be used if the shoes, S, provide sufficient height for the cutter. If one pair of wedge-shaped spacers, WSP, are substituted at each end of cross piece CP, the hand piece can be used at an angle. This feature is useful in obtaining best results from ball-headed cutters. The shoes S have the same width as cross piece CP. When they are swung around to line up with the cross piece, the flat side of the attachment can be drawn against a straight edge. This should not be done unless the working surface is absolutely free of grit. In any case the lower surfaces of shoes S should be covered with clean flannel strips, the free ends clamped underneath spacers SP (or cross piece CP if the spacers are not used). The heads of all four carriage bolts, CB, must be countersunk. Lock-washers, LW, should be used under all wing nuts.

Fig. 5. Two simple jigs. The device shown at left can be used for drilling vertical holes in sheets that are too large for accommodation in a drill press. The hardwood cross piece clamps the hand piece of a speed-controlled flexible shaft and two tubes which allow it to move smoothly up and down on the vertical steel rods securely fastened into the base. The position of the second tube determines the depth of cut. The center tube is also adjustable to provide more or less spring tension according to the type and size of drill or cutter used. To prevent slippage in critical cases, the hardwood base of the jig may be temporarily fastened to the surface of the sheet by means of double-sided adhesive tape. The jig in the foreground is for making straight cuts of given depth and length, using a high-speed portable router with adjustable depth gauge. The inside edge of the slot cut into the sheet acrylic base of the jig can be accurately positioned and the base temporarily fastened to the surface to be worked by means of double-sided adhesive tape. The two wooden pieces are adjustable stops. If parallel cuts are required, an eccentric shoe fitted to the router base will obviate frequent re-positioning of the jig. The shoe illustrated allows for twelve parallel cuts one-sixteenth of an inch apart between centers. If larger diameter cutters are used, fewer parallel cuts can be made. In all cases, turning the router counterclockwise on its base increases the distance between guiding edge and cutter.

loosened cutters and flying chips. In most cases it is desirable to use a mask over the mouth and nostrils. This question of protection appears to be taken for granted in trade publications, but it is a point that cannot be too strongly emphasized.

Variations in the sizes and shapes of cutters, the speed of operation, the angle at which the tool is held, and the direction of cut all provide variations in texture of the surfaces worked. It can sometimes be a problem to match, at some later stage, a particular texture determined by the different circumstances of an earlier occasion. In the earlier stages of experiment, it is well worth while to maintain a "texture record," giving details as to cutter type, size, and condition, the particular power tool, and the speed employed. When cutters are hand ground for a particular effect, one sample should be retained for reference.

When sheet acrylic is worked with the intention of edge-lighting the design, it is best to work in comparative darkness with a strip light along one or more edges. To begin with, an eighteen-inch fluorescent or incandescent tube in a suitable holder is sufficient. The strip light is placed along one edge. To avoid eyestrain, a visor can be placed over the lamp and the adjacent edge of the material. The work will light up as it progresses. Care should be taken that the sheet to be worked is placed on a piece of clean flannel, on which several folded strips of the same material have been laid, to prevent a stray particle of grit from making a continuous scratch if the material is moved. In Figure 2 a simple work frame is shown. The arrangement shown in Figure 3 provides greater flexibility but is far more elaborate. If grit or abrasive rubber wheels are used, care must be taken to remove the particles at frequent intervals by blowing or suction. When high-speed rotary cutters are employed in a router, the immediate surroundings of the working area can be protected with heavy cellulose acetate attached to the surface by double-sided adhesive tape. Templets are essential where accuracy is required or when there is the slightest risk of losing control of the tool. Simple depth-gauge and drilling attachments for flexible-shaft hand pieces are shown in Figures 4 and 5. The jig in Figure 5 allows making straight cuts of a given depth, up to four feet in length, on any surface with a portable high-speed router.

There is no material so workable as sheet acrylic and so equally efficient in the transmission of light. It will be readily understood that this efficiency works both ways; it lights up a planned design as well as the slightest accidental scratch and deeper gash. The latter cannot be easily wiped out, buffed off, or painted over, without visible trace. Every possible measure that can be taken to prevent accidental flaws is well worth the effort. Good grades of cast acrylic sheet are supplied with heavy masking paper on both surfaces, which should be retained in the earlier stages of preparation, in sawing sheets to size, drilling holes, and scraping and

polishing edges, and thereafter for as long as practicable.[6]

During the working of sheet acrylic, particularly in dry atmospheric conditions, both negative and positive charges build up on the surfaces of the material which seem to collect all the grit and dust in the immediate neighborhood. In these cases the worst possible thing to do is to wipe the surfaces with a dry cloth. Apart from aggravating the condition, this may result in hairline scratches which will show when the material is edge-lighted. If air pressure or suction is not available, the surfaces should be dusted lightly with a clean, dry piece of long-nap flannel, then wiped gently with a damp piece of the same material. Anti-static solutions are available. Some of these show white traces when the material is edge-lighted, and in any case they cannot be used if the surfaces are to be air-brushed, silk-screened, or painted. Isopropyl alcohol (99 per cent) is recommended for the wiping of the surfaces immediately before these operations. Electronic methods of static removal are generally too expensive for the small workshop.[7]

Finally, brief reference must be made to crazing which can be caused in sheet acrylic by stresses introduced into the material, uneven changes in temperature, or the chemical action of certain solvents. The resulting minute surface cracks are hardly visible in normal circumstances, but if the sheet is to be edge-lighted they can be a nuisance. Crazing need never occur if the material is treated with all due care and not subjected to stresses in excess of its tensile strength.[8] In practical terms this means good storage for the material before use, adequate support during working and after mounting, allowance for seasonal and other temperature changes, especially in large-scale exhibits, and discriminate use of cleaners and solvents. In permanent, stationary exhibits it is highly desirable to provide plate-glass protection for the front of an assembly of acrylic sheets. In others, the use of a transparent, neutral, smoke-tinted, protective sheet[9] not only improves the lighting effect but also provides a surface that can be washed with detergent and treated with anti-static wax. As it cannot "pipe" light, it can never reveal stains, hairline scratches, wax deposits, and so on, which would show up in an edge-lighted clear sheet.

[6] See Rohm and Haas Company Bulletin No. 1d, "General Information," page 2, under "Protective Coatings," and their Bulletin No. 15e, page 5, under "Masking Compounds."

[7] See Imperial Chemical Industries, Ltd., illustrated handbook *Perspex Acrylic Materials*, Part 2, "Machining," page 22; also Rohm and Haas Company Bulletin No 52d, "Cast Sheet, Painting," pages 3 and 4, under "Neutralization of Static," and pages 6 and 7, under "Sources of Supplies."

[8] See Imperial Chemical Industries, Ltd., illustrated handbook *Perspex Acrylic Materials*, Part 5, "Properties" for general, mechanical, and thermal properties, as well as chemical resistance, of Perspex. See also Rohm and Haas Company Bulletin No. 229b.

[9] Perspex: Neutral 912, Neutral 911 (lighter), Neutral 910 (lightest). Plexiglas: Grey 2074 (dark), Grey 2064 (light).

II

A little experience will convincingly demonstrate several points: 1. Cuts on the rear surface of a sheet light up more brilliantly, while those on the front surface appear diffused. 2. The depth and the shape of a cut and its position relative to the source of light provide variations in the intensity of glow when the material is edge-lighted (see Fig. 6). 3. The rate of light transmitted over a given distance varies with the thickness of the sheet and the area worked. The physical reasons for these effects will not be hard to understand, but the limitations they impose are not always appreciated.

To take advantage of the brightest light effects possible, it becomes necessary to work the majority of designs in reverse. When several sheets are used in the execution of a design, care must be taken to prevent accidental reversal of an element.

A design for edge-lighting in sheet acrylic cannot be planned without careful consideration of the nature and position of the light source and the thickness of the material to be used. In the case of a single source of light, the design should allow for progressively deeper engraving or carving as the distance from the light increases (see Fig. 6C). Whenever maximum possible intensity is required in the edge-lighting of any particular design, all edges of the material should be polished and those not required to admit light should be "sealed." Such sealing can be done with adhesive aluminum foil or with opaque white acrylic paint. Light tending to leave the sheet from such free edges will then be reflected back into the material. If the supply of light is not critical, the white paint can be applied directly to unpolished edges with slight loss in reflecting efficiency.

The working of larger elements in a design can easily bring about a state of despair in the less-experienced enthusiast. The outer edges of the carving will of course pick up the light, especially on the side closest to the source (see Fig. 6), but, unless carefully graded and smoothed, the general surface of the element may appear irregular or at best "pushed in." With care and experience the intensity of light reflected from a worked surface can be made to provide an illusion of three-dimensional depth. To achieve this end, it is best to begin carving a heavy element in the very middle and work carefully outward. The deepest point can be determined by drilling a hole to the depth required. Sometimes several holes of varying depth are desirable as reference points. For greatest accuracy a high-speed router with a built-in depth indicator can be used for this purpose; alternatively, an attachment similar to that shown in Figure 4 can be made to be clamped around the hand piece of a flexible shaft.

A tracing of the design placed underneath the material to be worked

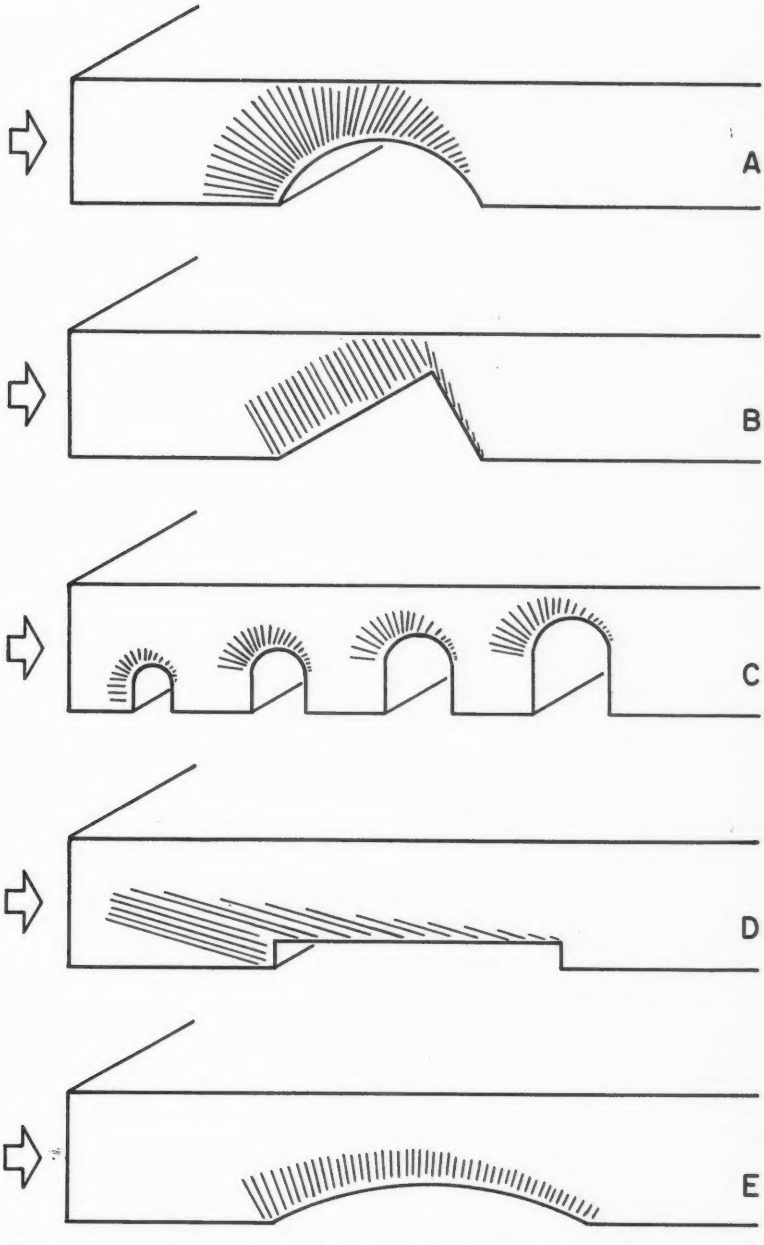

Fig. 6. Incident light is represented in each case by large arrow; light reflected from engraving, by straight lines.

is useful in sheets up to one-eighth of an inch in thickness. For thicker sheets allowance must be made for parallax. If an outline must be scratched into the working surface, it must fall within the outer boundaries of the element so that it can be removed as the carving is graded to the surface. In most cases it is worth while first to make an exact templet of .030 cellulose acetate, then to attach this by its outer edges to the working surface by means of double-sided adhesive tape, and, finally, to carve the material within the boundaries thus provided. Such procedure would help to reduce the risk of damage caused by one's losing control of the cutter.

The explanations to Figures 7 through 10 will provide further information in regard to the preparation of acrylic sheets for exhibits of small size. If the assembly is too heavy or too large, a modified procedure becomes necessary. A full-sized templet is first made of tempered Masonite or sheet metal, and the pilot holes are accurately drilled. After the sheets for the exhibit are cut to size, each sheet is securely clamped to the templet and drilled through the pilot holes, with full support provided on the under side of the sheet. The drilling attachment shown in Figure 5 is invaluable in these cases, as, apart from accuracy of the cutting angle, it can be made to provide speed variation, start, and stop, through a foot control. A more simple alternative is to drill a piece of hardwood of suitable size in a press and use this as a guide to keep the drill vertical to the surface of the material.

While the usual metal-cutting twist drills can be used for sheet acrylic, it would be rewarding to have full knowledge of the advice given by the principal manufacturers in regard to drilling operations.[10] Briefly, they recommend: a wider included tip angle of 140 degrees to reduce the cutting edge, a lip clearance angle of about 15 to 20 degrees, with as little margin between the cutting surfaces as possible; removal of rake to provide a scraping rather than a cutting edge. The rate of feed should vary inversely with the size of the drill. The speeds recommended are 7000 r.p.m. for one-sixteenth-inch drills, 1800 r.p.m. for quarter-inch drills and 900 r.p.m. for half-inch drills.

Beyond these initial suggestions, it would be presumptuous to recommend particular ways of handling power tools. An artist would hardly appreciate advice as to the manner in which he should hold his brush. Here the issue is even more involved. There is wide variation in the type, size, weight and balance, capacity, and performance of power tools. One person's conception of the right grip may seem awkward to another. Some tools feel comfortable to begin with, but after a few minutes' use,

[10] See Imperial Chemical Industries, Ltd., illustrated handbook *Perspex Acrylic Materials*, Part 2, "Machining," pages 12 and 13; also Rohm and Haas Company Bulletin No. 3d, "Cast Sheet, Machining," pages 2 and 3.

they may seem "top heavy" or too hot to hold. It is good practice, particularly when high-speed grinders are used, to change tools frequently to rest the hand and cool the bearings. Books and articles have appeared from time to time on the subject of internal carving in acrylic plastics. While the techniques recommended could be useful to the home craftsman or occupational therapist in the production of decorative paperweights, door knobs, pen stands, and other objects of small size, they would have little application in serious work on a larger scale. With due regard to considerations of safety, a good deal must therefore be left to individual circumstances and preferences, not only in the choice of tools but in their operation. The beginner should first acquire the feel of any convenient tool at his disposal. In the preliminary stages of experiment he will need a few ball-headed burrs and simple easy-to-sharpen cutters, some tapered twist drills, a small mandrel, a few cloth buffing wheels, coarse and fine compounds for scratch removal, a small grinding wheel, a pin vise, and a supply of old-style gramophone needles. In due course he will regard every broken or blunted drill or burr as a potential cutter which can be ground, retempered, and used down to the butt. He will make increasingly good use of his speed control. With more experience he will learn to interpret the various sounds of his tool, particularly when he is undercutting and cannot see his cutter. He will be able to appreciate the requirements of a design in terms of material thickness, types and depth of cut, and numbers and intensity of light sources.

With a little experience in the working of sheet acrylic and the factors involved in edge-lighting, one can readily understand the following points: 1. Any design executed on a sheet of cast acrylic can be made to light up in a particular color simply by staining the edge adjacent to the source of light and sealing the remaining edges. 2. If two or more worked acrylic sheets of the same size (but not necessarily thickness) are assembled one behind another, each bearing one or more elements of the complete picture, each sheet can be edge-lighted in a different color from the same light source.[11] 3. Color variation can be introduced into single- or multiple-layer displays by (a) using several sources of light, staining the adjacent edges as required, and providing means for switching the lights in any given order; (b) using a single light source within a revolving, transparent, multicolored drum or tube.[12] In such an

[11] United States Patent No. 1,707,965, April 2, 1929, entitled "Illuminated Sign" granted to F. H. Scantlebury long before the introduction of acrylic materials, describes a three-layer, three-color display of this type in which the design elements were sand-blasted into glass.

[12] United States Patent No. 2,524,657, October 3, 1950, entitled "Lighting Device" granted to P. B. Ford. In this case the duration of a particular color phase would depend on the band width of the color and the speed of the drive motor.

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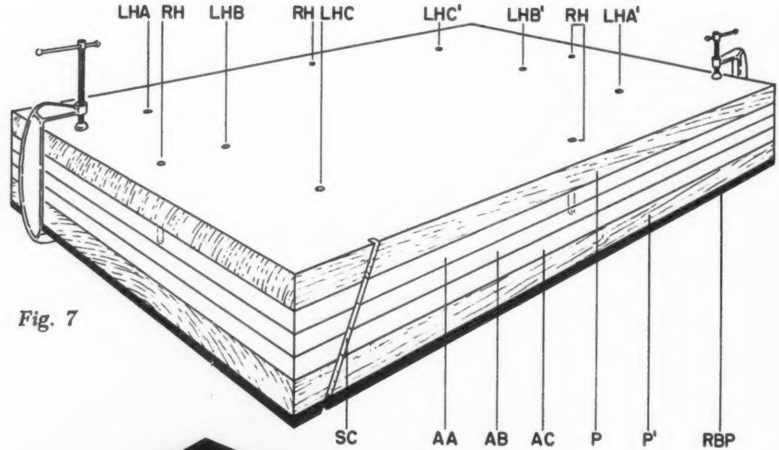
LHA
RH
LHB
RH
LHC
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RH
LHA'
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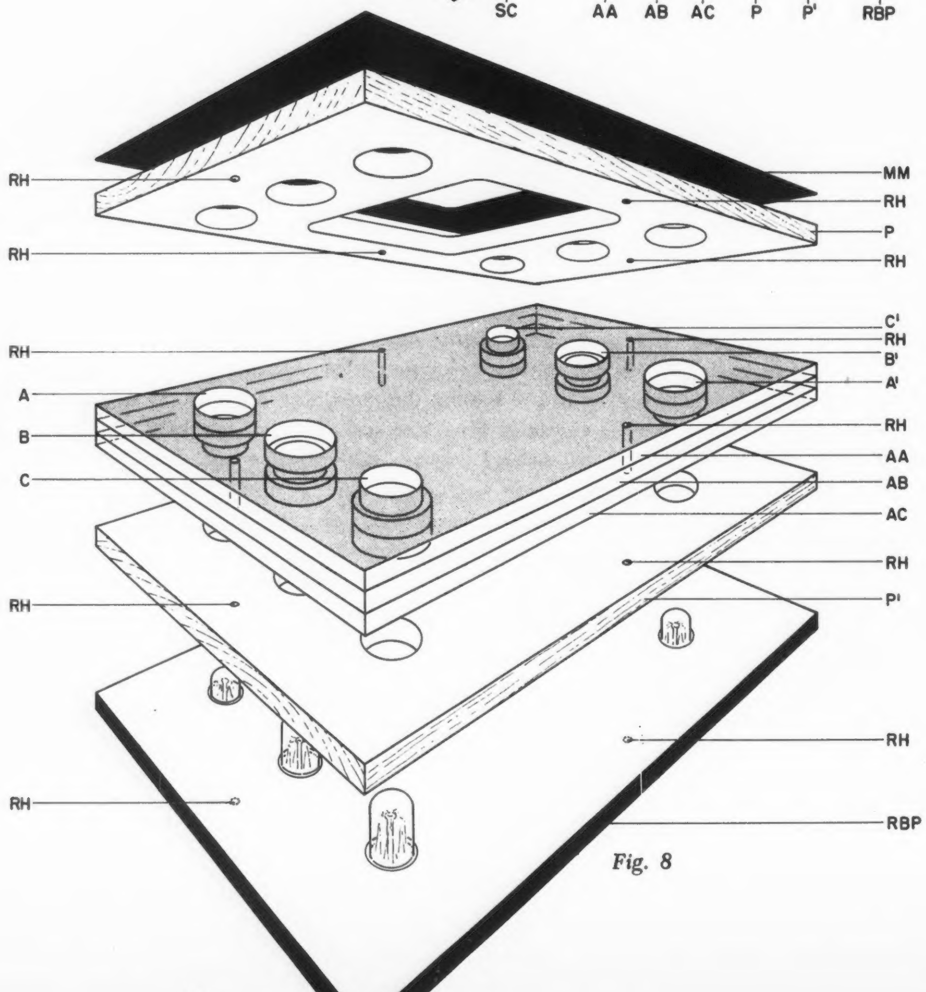
Fig. 7


RH
MM
RH
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RH
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C'
RH
RH
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P'
RH
RH
RBP

Fig. 8

Fig. 7. Preparation of material for a three-layer, six-lamp, animated unit (not to scale). The three acrylic sheets AA, AB, and AC and the two pieces of plywood, PP′ (or other suitable material), are clamped together after having been cut to size. A shallow saw cut, SC, on one side of the assembly is helpful in avoiding confusion in later stages, particularly in units with a larger number of layers. Four registration holes, RH, and six pilot holes, LHA, LHB, LHC, LHA′, LHB′, LHC′, are all drilled in a press at this time. The clamps are then removed. With circular hole-saws of appropriate size, the individual sheets are drilled to accommodate the six lamps in the five upper layers and the lamp holders in the final backing piece, RBP. The pilot holes insure that the large holes line up when the sheets are re-assembled.

Fig. 8. Second stage of preparation of three-layer, six-lamp, animated unit (not to scale). This exploded view shows the window cut in P through which the exhibit will be seen. A metal mask, MM, also with a window, covers the lamp holes in P. In this example each acrylic sheet has two small and four large lamp holes (see also Fig. 10). The small holes admit light into each sheet; the larger holes merely provide space for the lamps to project through and for the opaque rings OR (see Fig. 9) to be conveniently positioned. For more even illumination, the lamps that light up together (A and A′, C and C′) are placed at opposite corners. Before the masking paper is removed from the acrylic sheets, the edges of the small holes should be sanded and polished; the larger holes should be coated first with white, then black, acrylic paint. The registration holes RH in the acrylic sheets AA, AB, and AC are essential for the correct placement of the elements in a given design. Each layer to be worked is attached to its predecessor by means of these holes. If an over-all, full-scale design is provided, it should be in the form of a reversal photostat or a tracing on draft film or parchment which will allow it to be viewed in reverse. This sheet should be strengthened along its borders and accurately perforated for registration. Thereafter it can be used in the working of the acrylic sheets separately or collectively. After work on the acrylic sheets is completed, the registration holes RH are used for holding together the five sheets from P through P′ by means of carriage bolts (see Fig. 9). The heads in P (not shown) and the lock washers and nuts in P′ (not shown) should be appropriately countersunk. Once bolted, this assembly need never be taken apart. The registration holes RH in the removable panel RBP could be used for securing this component to the assembled sheets P through P′. In this case the holes are slightly reamed to allow projecting bolts to slip through easily. Four washers and wing nuts hold the panel in place. If the holes RH serve the double purpose of registration and assembly, their location deserves some consideration. Sometimes it is desirable not to have the holes arranged symmetrically so as to avoid accidental reversal of an acrylic sheet after the masking paper is removed. Irregularly placed registration holes will insure that a sheet will not be worked on a wrong surface. In other cases, particularly if large sheets are used in the assembly, it may be impractical to have a removable panel of the same size. These conditions require alternative means for mounting panel RBP. It may be desirable to provide separate mounting bolts, or it may be sufficient merely to push and lock panel RBP into position if the assembled layers fit within a framework. In every case the mounting holes should be clear of the lamp holes to facilitate the wiring of lamp holders mounted on RBP. They should not be visible when the assembled unit is viewed from the front.

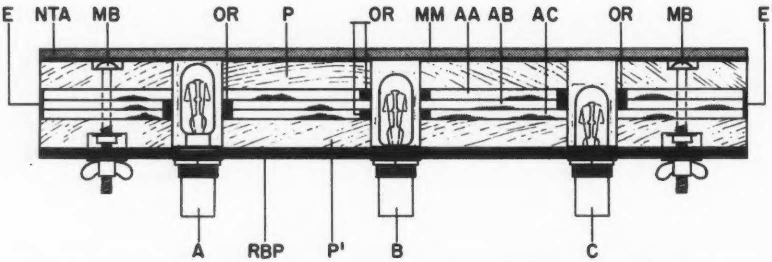


Fig. 9. Sectional view of three-layer, three-lamp, animated exhibit. The positions of opaque rings OR (see legend to Fig. 8), assembly and mounting bolts MB, and lamps A, B, and C are clearly shown. The acrylic sheets are sandwiched between two panels, P and P′. Panel P has a window (not shown) through which the exhibit will be seen. Metal mask MM, which also has a window (not shown), covers the lamp holes in P. A neutral, smoke-tinted, transparent acrylic sheet, NTA, covers the whole front surface of the unit. If the front surfaces of metal mask MM and panel P′ are painted black, nothing will be visible behind the smoke-tinted sheet NTA until the exhibit is in operation. The exposed outside edges of the three layers, E and E′, and the larger holes in the acrylic sheets AA, AB, AC, made to accommodate the lamps A, B, and C, are all "sealed" as described in the text. The opaque rings OR may be cut from Bakelite or metal tubing. Their purpose is to protect "sealed" edges and to prevent all possibility of undesirable leakages of light from one layer to another. Lamps A, B, and C, although mounted on the same removable panel, RBP, have been positioned to provide maximum intensity of light to the layers they illuminate. The type of lamp holder shown provides easy adjustment. Other types may need adapting to suit given conditions.

arrangement, if intensity of color and a sharp cut-off between phases are required, it is necessary to insert strips of masking material between the surfaces of the assembled sheets adjacent to the light source.[13] 4. Animation can be introduced into a display with two or more layers of sheet acrylic by using (a) several sources of light, sealing each layer from another so that the light from a particular source illuminates one layer and no other, providing means of switching the lights on and off in any given order (see Figs. 9 and 10); (b) one source of light enclosed within a revolving slotted drum which edge-lights the layers in succession (see Fig. 11); and (c) one source of light fixed above a slot and providing means for the assembled layers to pivot back and forth (see Fig. 12).[14]

[13] Such as metal shim, fiberboard, heavy black paper, or similar material. See masking strips, MS, in Figures 11 and 12.

[14] United States Patent No. 2,722,762, November 8, 1955, entitled "Means for Conveying Visual Indications in Transparent Materials" granted to G. S. Krajian.

In the planning of a particular exhibit, the above possibilities need not be considered separately. In most cases, combinations of different methods are desirable. The succeeding illustrations in this paper, and the explanations provided, will give some idea of the combinations possible, and these are not all. As every assembly has a backing piece, it is generally possible to drill this to admit acrylic rods or irregular shapes to "pipe" light from behind. This method can be used when it is required to identify certain elements or provide a succession of moving points to indicate motion or flow in a given direction. Back-lighting can be very successfully used for legends,[15] which remain completely invisible if a sheet of neutral transparent acrylic covers the face of the exhibit (see Figs. 9, 11, and 12). When particular elements of a working exhibit must occupy the same position in the viewing area, the preceding layers could obstruct a clear view of the succeeding, especially if heavy carving

[15] These may be engraved on Lamicoid (a translucent material with opaque front surface), silk-screened on opal light-diffusing acrylic, or could be merely negatives sandwiched between clear and opal sheet acrylic.

continued on page 139

Fig. 10. Acrylic sheets AA, AB, and AC of Figures 7 and 8 taken apart after having been worked. To facilitate illustration and explanation, a very simple example of animation is given here. Each sheet shows a rectangle of different size and position. When the sheets are appropriately assembled and sequentially edge-lighted, the unit shows a rectangle becoming longer and wider, then shorter and thinner, as it revolves. If the small holes that pipe light into each sheet are differently stained along the edges, the additional effect of color change is introduced.

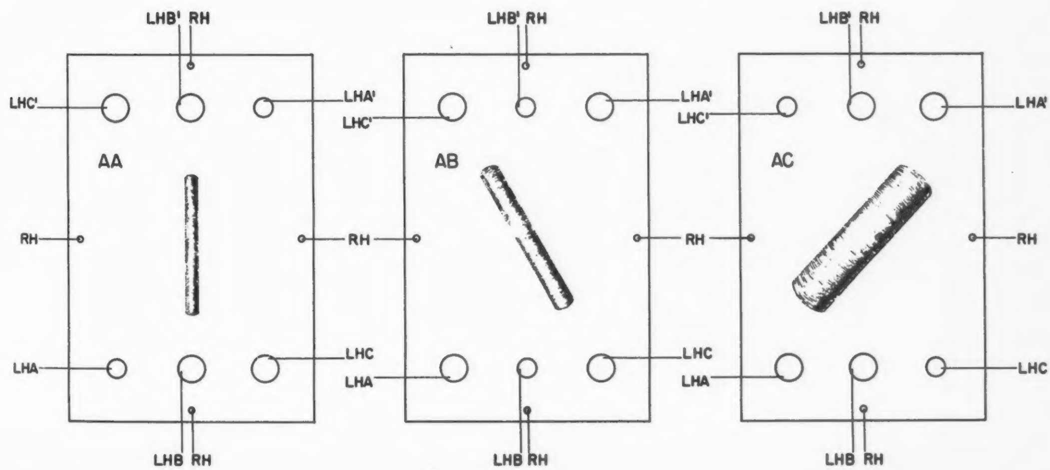


Fig. 11. Animation by means of a revolving slotted drum (not to scale). A stationary light source, LS, is inside a revolving drum, with equidistant slots of equal width extending longitudinally. The outer surface of the drum is close to the lower edges of the four sheets in the assembly. When the drum is revolved, the leading edge of one slot arrives at the outer edge of the first sheet as the trailing edge of its predecessor leaves the inner edge of the final sheet. When measured over the outer circumference of the drum, the width of the slot should be just under the edge dimension of the thinnest layer in the assembly. If the distance between the slots is exactly equal to the total thickness of the assembled sheets (as in the example shown), the cycle will be repeated without interruption. If "off" periods are required between each cycle, their duration will be determined by the distance between two slots and the speed of the revolving drum. The viewing surface of the exhibit is covered entirely by a sheet of neutral (smoky) transparent acrylic, NTA. This helps to prevent incidental white light outside the exhibit from reducing the intensity of colors in the unit. It also conceals layers which are not illuminated at a given moment. Thus, only one part of the total subject matter is visible at one time. The duration of each phase of a cycle may be varied by using sheets of different thicknesses. In the example illustrated, irrespective of the speed of the revolving drum, the phase duration of visible elements worked on acrylic sheets AA, AB, AC, and AD will be in the proportions of 2:3:2:4, respectively. A practical example of thickness variation is provided by a "working" heart exhibit. If each phase of the cardiac cycle is worked on a sheet having a thickness directly in proportion to its duration, in the assembled exhibit the heart can be made to "beat" faster or slower simply by changing the speed of the revolving drum. At all speeds the duration of one phase will always remain strictly in proportion to that of any other. The separating masks, MS, help to provide a sharp "cut-off" when the light moves from one edge to another. Such an arrangement cannot work unless the drum slots and the adjacent edges of the assembled sheets are strictly parallel. Parallel alignment is achieved by providing two screws at two convenient points on the mounting base for the revolving drum. Once they are adjusted and locked into position, no time will be wasted in alignment when the drum unit is removed for re-lamping.

Fig. 12. A hand-operated animation unit (not drawn to scale; the side of the unit is not shown). Two worked acrylic sheets, AA and AB, are assembled with a backing piece, BP. Exactly opposite each other, on the two sides, the assembly has bearings that connect it to the side walls of the unit, enabling the assembly to rock to and fro at pivoting point P. The upper edges of the acrylic sheets are parallel to the slot that admits light from source LS. In the normal rest position, layer AA remains illuminated. Push button PB moves the upper edge of the assembly forward, cutting off light into AA and illuminating AB. When the button PB is released, spring SP pushes the assembly back to the normal rest position. As in the example given in Figure 11, the face of this unit is entirely covered by a sheet of neutral (smoky) transparent acrylic, NTA, which reveals only the sheet illuminated at a given time. The area CA behind the sheet NTA could be used for explanatory copy if the reflector around light source LS is adapted to allow the message to be backlighted. The layers of material used need not be limited to two. However, when more sheets are used, a rocking movement cannot provide a continuous cycle. While the revolving slotted drum will edge-light AA, AB, AC, AD, and

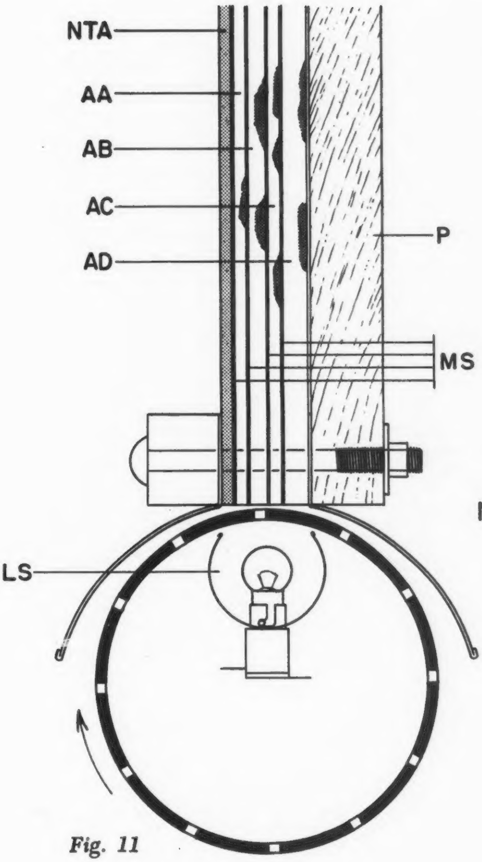


Fig. 11

so on, the rocking unit will show AA, AB, AC, AD, AC, AB, AA, and so on. Several modifications are possible. If viewer participation is not required, push button PB can be eliminated and the rocking action can be provided by a timed rotary solenoid, or a small electric motor with a camshaft or merely fitted with an eccentric cam pushing the lower edge of the assembly against a spring.

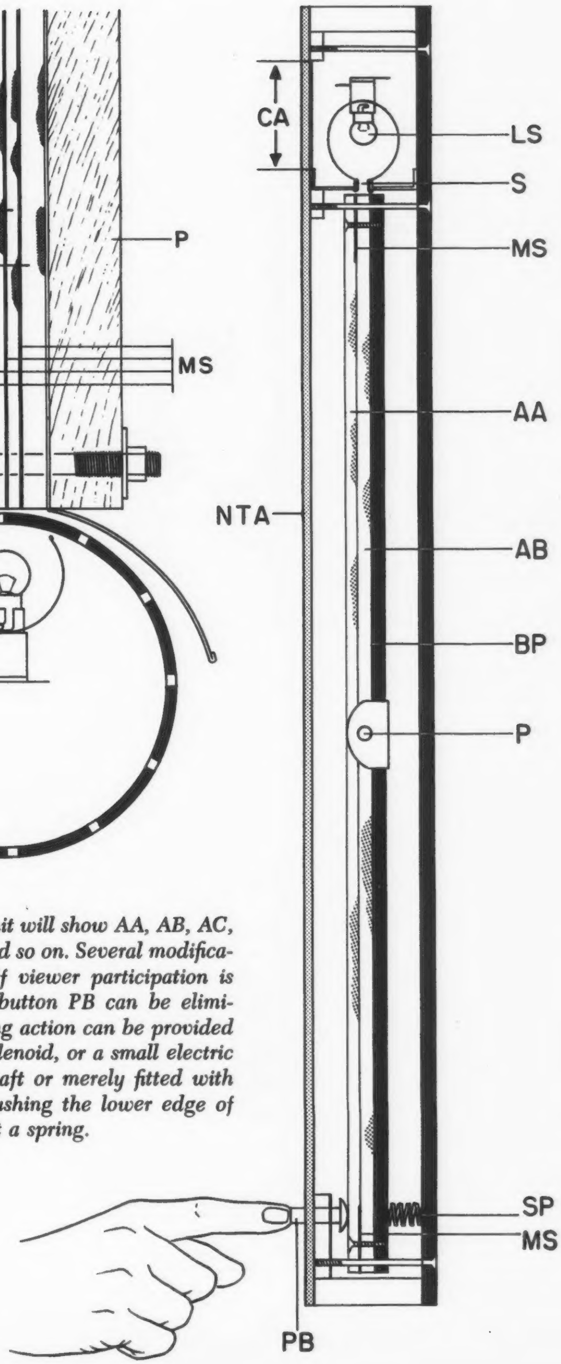


Fig. 12

Fig. 13. Control unit for an exhibit demonstrating uterine changes during four phases of the menstrual cycle. The acrylic disc RAD (in A) is one-half inch in thickness and deeply carved in four places on its outer surface. It is mounted on a revolving Bakelite disc (not seen) by means of screws S1, S2, S3, S4. To prevent any possibility that dust can enter the carvings, the upper surface of each quarter is sealed with sheet acrylic one-sixteenth of an inch in thickness. The control unit fits into a box that has the remaining elements of the exhibit attached to its front surface. The disc RAD automatically lines up with an acrylic sheet of the same thickness which pipes light into the disc from a source above. The remaining sheets in the assembly are also edge-lighted from this source, but these remain stationary while the disc RAD makes a quarter turn for each phase of the menstrual cycle. The four micro-switches, MS1, MS2, MS3, MS4, light up the explanatory text to each phase and are operated by an adjustable stainless steel cam, C, shown near MS4. These switches also control the bulbs that illuminate the ovum in different stages of development in the right ovary (see Fig. 14). In addition, MS2 operates an intermittent light to indicate descent of the ovum into the right Fallopian tube, and MS4 energizes an adjustable timer controlling additional illustration and text in phase 4 (also not shown). Figure 13B shows the control unit from the back, with subassemblies removed from the mounting posts and turned aside. In 13C the unit is shown with subassemblies fastened down and the protective metal cover in position. The phase timer, PT, controls the duration of each phase. By changing the position of adjustable stop AS, the "on" period of each phase can be lengthened or shortened. The synchronous motor SM is fitted with a slip clutch. When the sweep arm SA hits the stop AS, the motor automatically reverses, and the arm returns to raise the weighted lever of microswitch MSS. The motor reverses again when the arm hits adjustable weight AW. (The tip of MSS lever is shown in dotted lines.) During the odd second, microswitch MSS lever is raised, and solenoid S pulls up the weighted stop on polyethylene arm PA, releasing Bakelite disc index DI. This in turn releases microswitch MSM which darkens the exhibit and operates the motor M. (The exhibit and legends are not seen during changes from one phase to another.) The weighted stop on PA rides on the outer rim of index DI until it falls into the succeeding recess at RE. At this point microswitch MSM cuts off power to the electric motor M and illuminates the exhibit in a new phase. The succeeding phase appears when the sweep arm SA returns to the adjustable weight AW on the lever of microswitch MSS. Shown also in B and C are the 110-volt fuse F and input connection I 110 V, remote control receptacle RCR, 110- to 8-volt transformer T, 8-volt receptacle for synchronized caption lights OC8V, a second adjustable timer, T2, which operates, when required, supplementary illustrations and legends during phase 4. The controls are located in the front of the exhibit: exhibit on-off, supplementary information on-off, immediate phase change, and phase time extension to "hold" the exhibit for any period required.

Fig. 14. Four phases of the exhibit on the menstrual cycle controlled by the unit shown in Figure 13. The viewing surface of the exhibit is twenty-eight by thirty-six inches. Half of this area is taken by the legends (not shown) which light up, one at a time, in synchronization with each phase. The legends are negatives sandwiched between a front sheet of clear, and a backing sheet of opal, light-diffusing acrylic. The sandwich is fitted to the face of a parti-

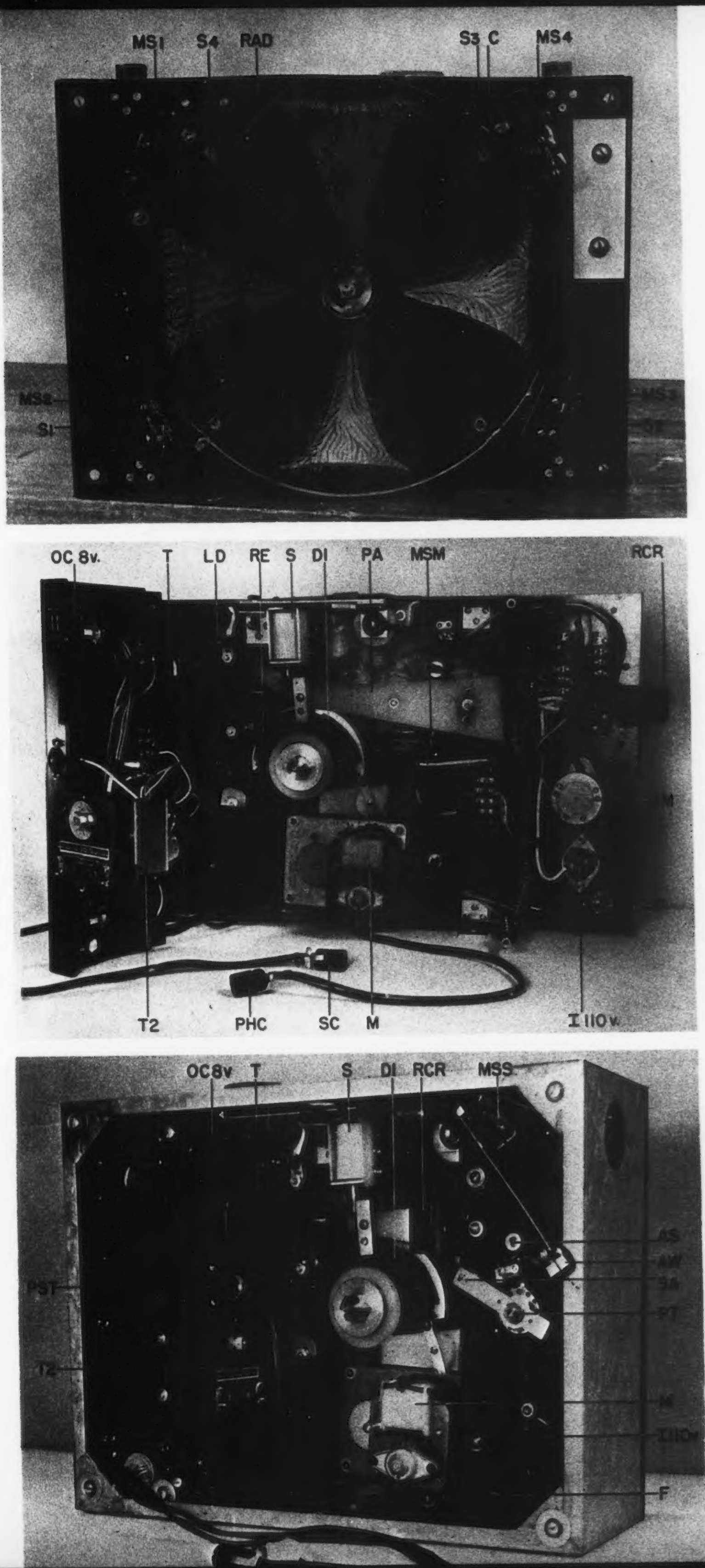
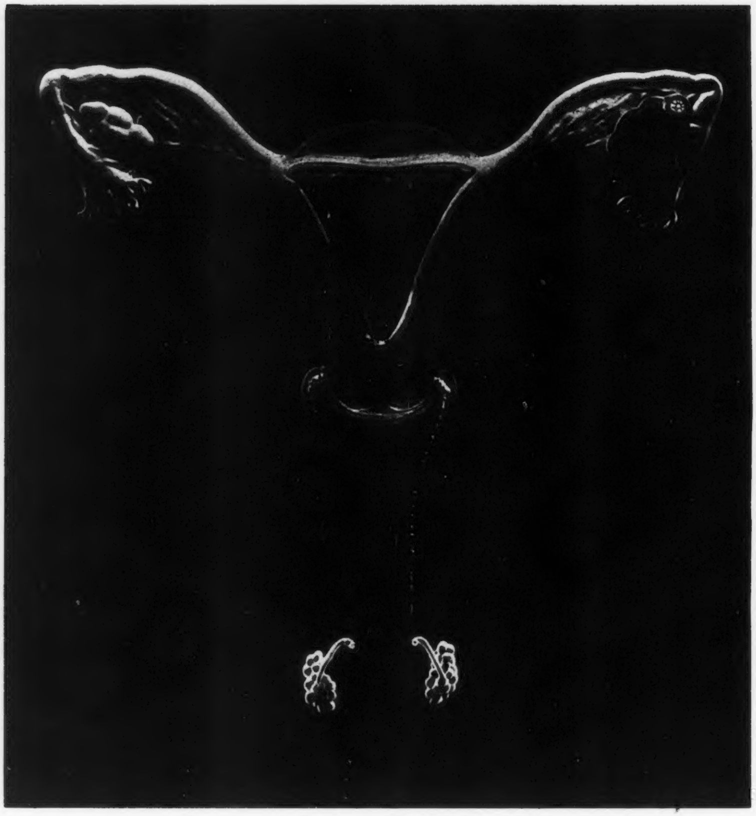

MS1
S4
RAD
S3
C
MS4
S1
OC 8v.
T
LD
RE
S
DI
PA
MSM
RCR
T2
PHC
SC
M
I 110v.
OC8v
T
S
DI
RCR
MSS
F

Fig. 13



tioned metal light box. The exhibit unit and the box for the legends are mounted side by side behind the neutral transparent (smoky) acrylic sheet which covers the whole face of the exhibit. No divisions can be seen between the units that make up the exhibit. The appropriate legend in color appears to float to the right of the viewing area. The legends read: A. Postmenstrual Phase: After menstruation, endometrium (lining of uterus) is thin. Ovum (egg) begins to mature in Graafian follicle (egg sac) of ovary. B. Intermenstrual Phase: Graafian follicle ruptures. Ovulation occurs as matured ovum leaves ovary and enters Fallopian tube. Endometrium thickens. [The entry of the ovum into the Fallopian tube is indicated by an intermittent light and is not shown here.] C. Premenstrual Phase: Endometrium prepares to receive ovum. If unfertilized, ovum disintegrates. Corpus luteum, formed from emptied Graafian follicle, begins to shrink. D. Menstrual Phase: Thickened endometrium, no longer needed, is shed with menstrual flow. Corpus luteum continues to shrink. A new menstrual cycle is ready to begin.

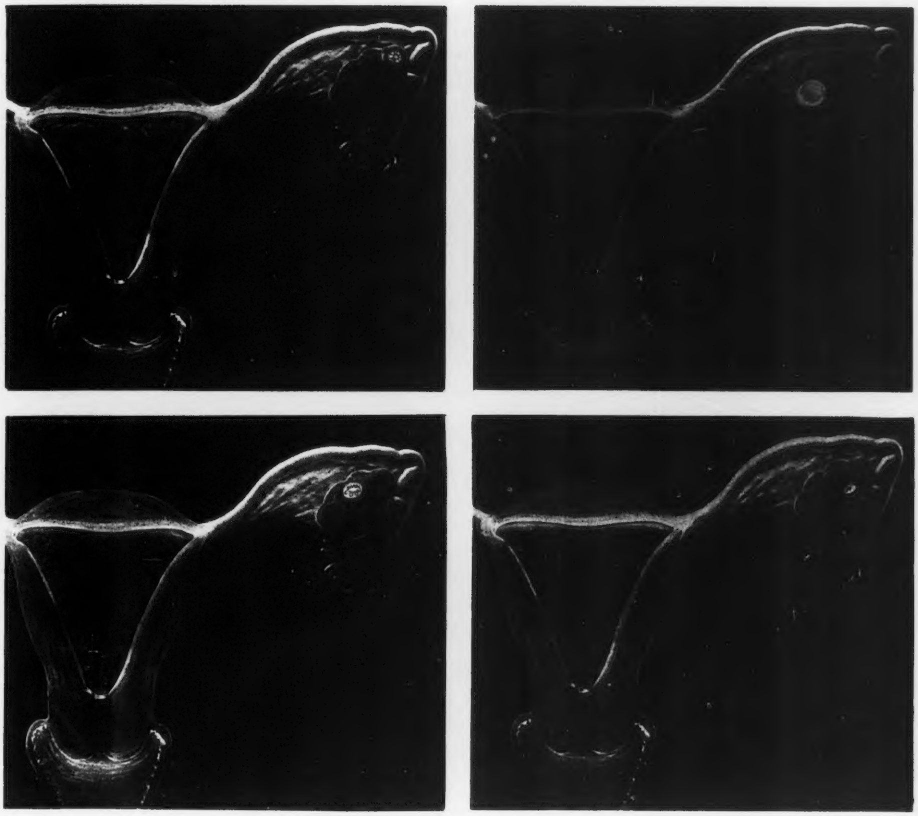


Fig. 14

is used in the design. Figure 13 shows how this difficulty was overcome in a model explaining the menstrual cycle. In this instance the exhibit was required to operate automatically. A hand-operated, revolving, edge-lighted disc would be a relatively simple problem.

It would be very difficult in a brief article to detail combinations and alternative methods of presenting a given subject in an animated exhibit. For the same reason, very specific recommendations cannot be made in regard to the sources of light that can be used.[16] Several factors must be

[16] In all illustrations provided with this article, the lamps shown merely indicate light source and should not be taken as a recommendation of a particular type. Thus in Figures 11 and 12, the light source could be fluorescent, incandescent line filament, cold cathode, or a row of small, low-voltage, automobile lamps mounted on a supporting strip or inside a reflector.

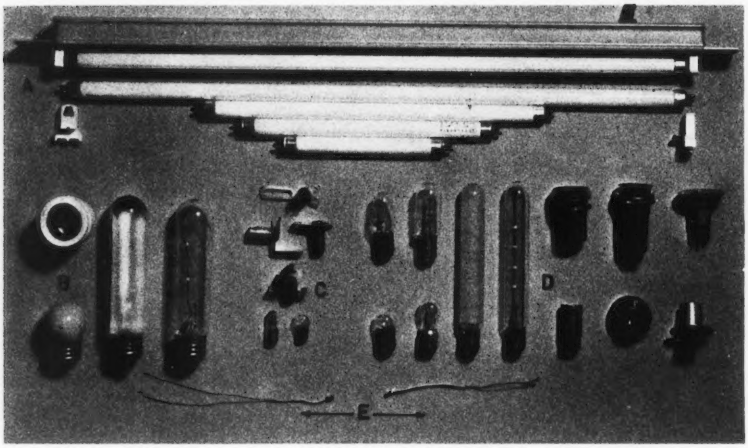


Fig. 15

taken into consideration in the planning of each exhibit. In a unit that is not required to travel, considerations of adaptability to different conditions do not apply.[17] In both mobile and stationary exhibits the choice of lamps used is of greatest importance. Incandescent lamps present a heat problem. They are not suitable for continuous illumination[18] unless adequate ventilation is provided. Fluorescent lamps, even those equipped with "trigger-start" ballasts, do not immediately respond when switched on. The life of line-filament lamps is adversely affected by vibration and rough handling. A row of small, rugged, automobile lamps fitted into a reflector can take vibration and shock, and, if one or two burn out, their loss is hardly noticed, but here a heavy power transformer is necessitated. Small neon lamps do not have sufficient intensity for edge-lighting. Figure 15 shows a variety of lamps which have been used with success.

III

Because of space limitations, control units cannot be discussed in detail. Figure 16 shows a simple representative unit which controls the animation of the exhibit shown in Figure 17. For the majority of cases, the control

[17] Among these are weight, ease of setting up and packing, vibration in travel and rough handling, differences in voltage and type of current, and general availability of lamps used in case replacements are required.

[18] This does not mean that the exhibit cannot be continuously operated. An exhibit can be made to function indefinitely if each lamp used in its operation is given a brief "cooling-off" period. Fluorescent and cold cathode tubes may be left on continuously without appreciable increase in heat.

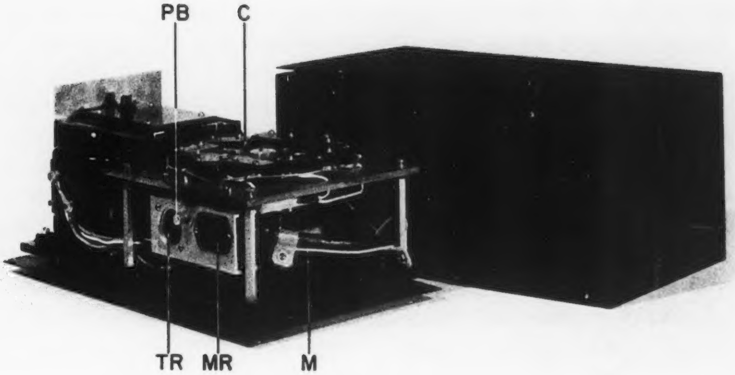


Fig. 16

Fig. 15. Some lamps used in edge-lighted exhibits. The fluorescent lamps (A) are nine-sixteenths of an inch in diameter. They all require appropriate ballasts and starters (not shown). Lamps with screw bases that are shown at left are not suitable for use in traveling exhibits. The first two lamp holders shown at the right are identical. In the first sample the holder has been pushed into the protective sleeve to allow the lamp to project farther out. This type of holder is shown in Figure 9. The trade reference to the lamps that are shown in this figure are as follows (all lamps are for 110 volts unless specified otherwise): A (from top to bottom): fluorescent F13T5/WW, F8T5/WW, F6T5/WW, F4T5/CW. C (from left to right): 6V auto instrument GE44 and 6V auto instrument GE55. D: At top left, the left lamp: 15T7DC; the right lamp: 25T8DC; at bottom left, the left lamp: 6V automotive interior lamp GE No. 82; the right lamp: 6S6DC. The right group, the left lamp: 25T6½DC/IF; the right lamp: 25T6½DC. E: Six-volt "grain-of-wheat" bulbs. The DC signifies double contact, not direct current.

Fig. 16. A simple control unit with protective cover removed. The motor, M, used here is a shaded-pole, slow-speed, silent-running unit with its gear train enclosed in a reservoir of oil. The shaft carries a non-adjustable cam, C, which operates two adjacent roller-lever microswitches at one time. The operation sequence is therefore fixed: AB, BC, CD, DE, EF, FG, GH, HI. The two-wire receptacle, TR, takes the plug from the "on-off" switch located in another part of the exhibit. The push button, PB, cuts out power supply to the motor whenever it is required that the exhibit be operated manually, phase by phase. The twelve-wire receptacle, MR, provides eight-volt controlled power supply through the eight microswitches to the lamps that animate the exhibit. A receptacle for a power supply of 110 volts A.C. to the transformers and electric motor is on the left (not shown). This control unit animates the exhibit shown in Figure 17.

unit consists of (1) a small motor fitted with a cam which operates a number of switches on and off at exact intervals in a given order, or (2) a small motor driving a shaft fitted with adjustable or fixed cams operating a number of switches. The second type is more flexible, as it allows an independent interval of operation for each switch. These units can be ordered from manufacturers of control equipment; specify (1) duration of complete cycle, (2) number of switches required, (3) whether the unit is to work continuously or on push button.[19] Adjustable cams are standard and are easily arranged to go on and off, once in each cycle. If several operations are required in the same cycle, an appropriate cam can be made from a brass or Bakelite circular blank. If their time intervals coincide, the legends can be illuminated by the same switches that control the appearance and disappearance of particular elements; otherwise, time-delay relays or separate switches must be provided.

The tape recorder provides an easy means for the synchronizing of sound with the operation of an exhibit. However, the success of a sound system depends entirely on the quality of the equipment used and the maintenance provided. Tape cartridge players are relatively inexpensive, but they necessitate lubricated, double-coated recording tape and are generally more susceptible to weather conditions. Reversing two-direction units can handle the heaviest Mylar tapes and allow greater flexibility in length of message. They are certainly to be recommended if their expense can be justified. A tape recorder of the latter type is used with the electronic control unit shown in the final illustration (Fig. 18). While this was built to operate an exhibit on the complex subject "Tranquilizers, Barbiturates, and the Brain," it requires only a different sound track, and a few minutes for resetting, to control another exhibit on a totally different sub-

[19] In the latter case a one-cycle unit is provided which automatically stops at the end of the operation. It is triggered automatically or by means of a push button.

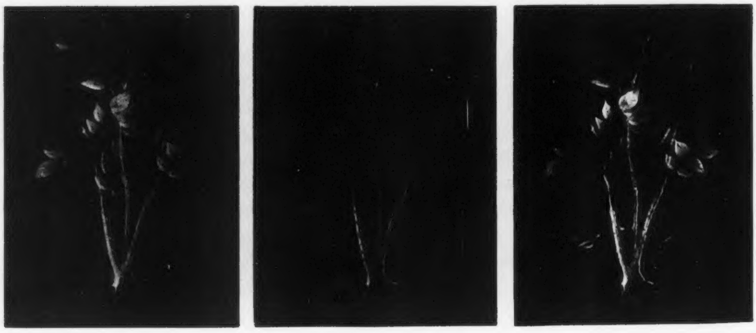


Fig. 17

ject. With the use of half-track, it can be made to explain the exhibit alternately in technical terms for the scientist or in simple words for the layman; alternatively, first in one language, then in another. With the use of quarter-track, it can provide either alternative at the flick of a switch.

IV

Certainly in time newer and better ways will be found to work sheet acrylic and exploit its edge-lighting properties; it would hardly be possible to wish for a better material. Harder plastics are already available. CR-39 is claimed to have five times the surface hardness of acrylic, but it cannot be cut, engraved, carved, or shaped so easily. The grit that provides the principal difficulty in the working of sheet acrylic can also mar the surface of CR-39, but in the latter case scratches are more difficult to remedy. Acrylic may be susceptible to certain solvents, but these same chemicals would also adversely affect most materials used in museum exhibits.

In common with every other medium, cast acrylic has its limitations, but these are more than outweighed by its advantages. While some of its physical properties are equalled or bettered by less expensive materials, both natural and synthetic, its exceptional optical properties place cast acrylic in a class by itself. In edge-lighted, animated exhibits the best qualities of cast sheet acrylic are fully exploited.

V

Grateful acknowledgments are due to Miss L. M. Magistrate and Mr. A. A. Gibson of Imperial Chemical Industries (New York), Ltd., and to Mr. R. G. Marshall of Rohm and Haas Company, Plastics Department, for the latest information on available technical literature published by their respective companies.

Freedom from patent rights must not be assumed.

Fig. 17. An exhibit demonstrating the effects of iron deficiency in soil. In eight phases of four seconds each, the "rosebush" shows symptoms of iron chlorosis as well as remedial action resulting in recovery and improved growth. In phase 1 (A) the leaves are green and the veins barely visible. In phases 2 and 3 the leaves become first pale green, then yellow (B), while the veins retain most of their original color. Phases 4 and 5 show the application of the recommended iron chelate and its absorption by the plant. In phases 6 and 7 the leaves return to normal. In phase 8 the plant shows additional branches with foliage and rosebuds (C). The height of the rosebush is twenty-one inches; the depth of the assembled acrylic sheets in the unit is one and three-quarters inches. Eight-volt lamps of small size were used for illumination; cooling time was provided for each set to allow the exhibit to be operated continuously.

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PLEXIGLAS:

Rohm and Haas Company, Washington Square, Philadelphia 5, Pennsylvania.
Plexiglas Design, Fabrication and Molding Data: Bulletins: No. 16, "Cleaning and Polishing Instructions"; No. 53, "Light Transmission Characteristics"; and No. 175, "Piping Light with Plexiglas." The following Bulletins are available singly or spirally bound together in Manual No. PL-28g: No. 1d, "General Information" (4 pages, illustrated); No. 2b, "Cast Sheet, Cutting" (8 pages, illustrated); No. 3d, "Cast Sheet, Machining" (4 pages, illustrated); No. 4d, "Cast Sheet, Forming" (24 pages, illustrated); No. 7c, "Cast Sheet, Cementing" (16 pages, illustrated); No. 8d, "Cast Sheet, Maintenance" (4 pages); No. 9c, "Cast Sheet, Finishing" (4 pages, illustrated); No. 52d, "Cast Sheet, Painting" (7 pages); No. 10d, "Cast Sheet, Annealing" (3 pages, illustrated); No. 14b, "Cast Sheet, Designing" (11 pages, illustrated); No. 15e, "Sources of Supplies" (8 pages).

LUCITE:

E. I. duPont de Nemours and Company, Inc., Wilmington, Delaware, have ceased to manufacture sheet Lucite. Technical bulletins which were previously available are now out of print.

Fig. 18. An electronic control unit designed by Dr. Herbert M. Teager of the Massachusetts Institute of Technology, Cambridge, Massachusetts. This fully transistorized control unit is capable of handling an animated exhibit of thirty-two elements with synchronized sound. The length of the sound track may vary from a few minutes to several hours, depending on the capacity of the tape playback unit employed. Up to eight on-and-off operations can be performed at fifty points in the course of the explanatory text, or sixteen operations at twenty-five points. Each element is controlled by two relays of plug-in type, R, one for switching on, the other for switching off. These have been mounted in the upper part of the control unit in four modules of sixteen relays each. Each module is provided with facilities for test checking. The small neon lamps NLR below each pair of relays indicate the operation of every element at a glance. The task of setting the control unit is greatly facilitated by a chart showing the on-and-off sequence of each element in the course of the complete story. The required number of wires can be color-coded, or numbered, for easy identification of each element. One end of each wire bears a slip-on connector which engages one of 400 bank terminals, BT, of the rotary stepping switch, RSS; the other end goes to

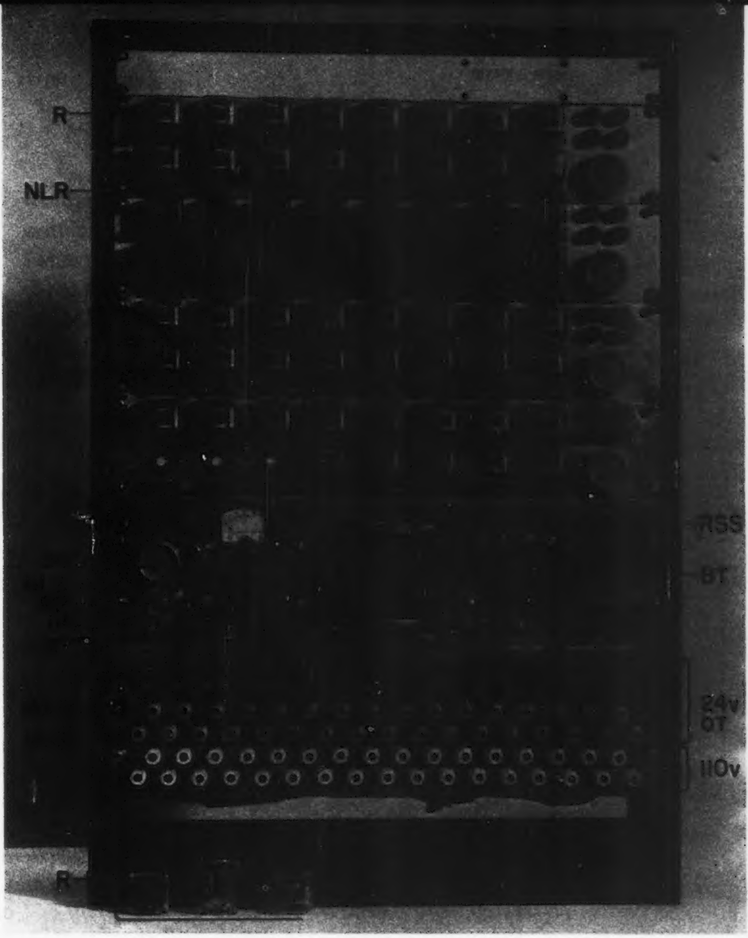


Fig. 18

the 24-volt operating terminal, OT, of the appropriate relay. After connections are completed, a manual push button, MSS, can be used for checking the sequence of operation. A push-button homing switch, MHS, is also provided for convenience at this stage. The neon lamps NLS give visual indication in test checking the wiring of the rotary stepping switch. The tape recorder is then connected through plugs IP and BP to the control unit which is set for recording by means of switch RP. As the message is played, the operation of push button BG imposes a high-frequency "beep" tone at desired points in the course of the text and one at the end. The processed tape is then removed from the tape recorder and retained as a master from which further copies can be made. With switch RP in playback position and "beep" output BP disconnected, the control unit is ready for operation. Each recorded "beep" tone will pulse the rotary stepping switch RSS one bank at a time, operating the relays in the order set. The final "beep" tone returns the switch to the home position. If the controls are set for automatic operation, this process will be repeated as long as required. Alternatively, the control unit may be set to stop at the end of the message and be reset by means of push button, a photo-electric or proximity relay.

Dedication of the Oceanographic and Ornithological Laboratories, Peabody Museum of Natural History Yale University

The formal dedication and opening of a new wing at the Peabody Museum were held on October 30, 1959. This wing, which adds substantial new space to the Peabody Museum, has been designed primarily to house the Oceanographic and Ornithological Laboratories; it also contains office and storage space for the Divisions of Anthropology and Invertebrate Zoology. The successful completion of the new building and the installation of its equipment give Yale University excellent facilities for the housing of collections, the study of live specimens, and for research and graduate instruction in the fields of oceanography and ornithology.

On the occasion of the dedication of the new laboratories four talks were presented; by S. Dillon Ripley, Director of the Peabody Museum; by G. Evelyn Hutchinson, Professor of Zoology at Yale University; by Daniel Merriman, Director of the Bingham Oceanographic Laboratory; and by Karl K. Turekian, Assistant Professor of Geology at Yale University.

CURATOR *takes pleasure in publishing the text of these addresses by four authorities in their respective fields of science, in which are expressed some thoughts concerned particularly with the place of the museum, and especially the museum of science, in the university community.*

S. DILLON RIPLEY

What are the origins of our own Peabody Museum? They commence in the early nineteenth century, with the professors of the time interested in the world of scientific collecting which had achieved a kind of renaissance in eighteenth century Europe with the great voyages of exploration. American men of science were reacting strongly to this new wave of enthusiasm for the wonders of the far corners of the earth. Benjamin Silliman at Yale had already donated a cabinet of minerals, as a scientific collection was called in those days. Silliman, a man of commanding abilities, who

incidentally wrote the first technical paper describing the possibilities of refining fuel from the shale and petroleum-bearing rocks of western Pennsylvania, forerunner of the oil industry, was determined that Yale should have a museum. No university could be a university without one, any more than it could lack a library. His younger associate, James Dwight Dana, was equally convinced. Dana, whose celebrated correspondence with Charles Darwin on the subject of coral reefs deserves a chapter in itself, was a prime mover in the creation of a natural history museum at Yale. It was he who helped secure the appointment of the first professor of zoology at Yale, Addison E. Verrill. In 1865 Dana was already writing of Verrill that he was "bringing in collections rapidly for our Museum" and was "distressed for space" (familiar words!). And Verrill was hard at work in concert with the United States Fish Commission investigations, already amassing materials.

The direct impetus was the act of George Peabody in 1866, who gave $150,000 to Yale for a museum of natural history. Peabody was the first American international banker. He was the first really broad American philanthropist, founding three museums, at Yale, Harvard, and Salem, Massachusetts, a normal college for teachers in the South, as well as homes for indigent boys in London and other benefactions. His junior partner, a young man from a Boston textile firm called Junius Spencer Morgan, eventually took over the bank and gave it his name, but Peabody had started it and built up what, for the time, was a huge fortune.

A second stroke of luck for Yale was the first director, George Peabody's own nephew, Othniel Charles Marsh. Marsh as director was a sort of "Orlando," interested in everything, expert at a number of things. A man of means in his own right, Marsh provided an impetus which the museum has never lost. His own collections in vertebrate paleontology were superb, conceived and financed with boldness and brilliance at a time when the West was being explored and opened. Fossils from dinosaurs to pterodactyls rolled into the museum by the carload—witness our cellars crowded to this day. While riding the tenuous, embryo lines of the Union Pacific, he collected Indian artifacts, convinced that the Indians of the Plains were a vanishing race, as indeed they proved to be. On a holiday in Egypt, he made one of the first important collections of Egyptian antiquities. His correspondence circled the globe. His prying fingers were everywhere, bent on enriching Yale's collections. In 1877 he cabled Berlin, offering a large sum for the second specimen of *Archeopteryx*, the fantastic fossil bird from the slate quarries of Bavaria, one of the few true missing links in biological science. Germany rallied to protect its own. Siemens, the electrical magnate, was pursuaded to outbid the American offer and save the specimen for the Berlin Museum, but if there had then only been another specimen of this great rarity, it would surely have been "extracted"

by Marsh for the coffers of Yale. This was one of his few failures.

Recently my colleague, the present Curator of Vertebrate Paleontology, came upon a specimen which in the past years had gone overlooked. The quagga, an extraordinary creature, half-horse, half-zebra, became extinct in South Africa in the 1870's. The last specimen in captivity, a female, died in the London Zoo in 1872 and should by rights have wound up in the British Museum collections. The skin could not be preserved, but the skeleton of the last living quagga is here at Yale, reposing all unknown in our collections. No one now knows what transpired. Suffice it to say that Othniel Marsh was an avid, even a voracious, collector. Something strange happened, the record is blurred, but the quagga rests at Yale for future generations to ponder upon.

One of the great jewels in the diadem of Yale is our collection of specimens of the tribe of fossil horses, showing the evolution of our four-footed friends from the very earliest horse, no larger than a jack-rabbit, with five toes, right through to the present, a complete sequence spanning fifty million years of evolution. Eighty-three years ago Marsh was discussing Yale's unique sequence in fossil history with an English visitor, Thomas H. Huxley, Darwin's great sponsor and champion. The earliest five-toed horse had still not been found, but Marsh was then on the verge of the discovery.

"What shall it be called, this earliest horse," was the speculation, and out of this the name *Eohippus,* the dawn horse, came. Two months later Marsh came upon the missing link, the first specimen of the five-toed horse and called it just that.

While talking with Marsh about missing links, Huxley drew an amusing sketch, rather in the style of Thackeray's drawings. The sketch shows *Eohippus* and on it Huxley, who said, "But he needs a rider," promptly supplied his own idea of one—"*Eohomo.*"

And so it goes. The parade of the past becomes part and parcel of the parade and pageantry of the present. Our collections form a document, to be studied, to be worked with constantly, to present the whole changing pattern of our universe. We cannot exist without our museum. The use and utility of its collections are validated time and again and will continue to be so as long as our culture survives.

G. EVELYN HUTCHINSON

Beetles serve for divers uses, for they both profit our mindes, and they cure some infirmities of our bodies.

A natural history museum, considered in terms of its purposes, may be defined as an institute for the study of the diversity of nature. This is true even if the student is a four-year old child who can learn that, although monkeys and elephants are very different, in each both front and back legs are organized on the same principle, "one bone, two bones and a lot of little bones." It is equally true of the paleontologist using the same principle of homology in attempting to solve the still obscure problem of the origin of the five-toed limb. It was such diversity in unity that Charles Darwin perceived when he compared his skins of Galapagos mockingbirds from the different islands and found that their beaks differed, writing in his notebook in 1835 "when I see these Islands in sight of each other and possessed of but a scanty stock of animals tenanted by these birds but slightly differing in structure and filling the same place in nature, I must suspect they are only varieties. . . . If there is the slightest foundation for these remarks, the Zoology of Archipelagoes will be well worth examination; for such facts would undermine the stability of species." This was the germ of his interest in evolution, the full significance of which we have doubtless not yet appreciated.

Several ancient peoples, notably the Egyptians and the Aztecs, kept a variety of wild animals for pleasure. Aristotle, the most significant pure biologist of the ancient world, is said to have received collections that Alexander the Great sent back from his campaign to his old teacher. Little, however, can be said about the history of natural history in the ancient world. The immediate precursors of the collections in the buildings, the opening of which we are attending, do not go back much beyond four hundred years. This four hundred years of history is very illuminating.

The history of natural history in western Europe may be subsumed under three periods. The first or medieval, from the twelfth century to the beginning of the sixteenth century, saw the beginning of the study of Greek and Arabic texts, and the production of a few original works such as the biological writings of Albertus Magnus and the famous work of Frederick II on falconry, the relation of which to the earlier Arabic works apparently requires further study. The main significance of the medieval period does not lie in these sporadic literary contributions which were sparse in comparison with the ever-popular and almost entirely fabulous bestiaries based on the "Physiologus." What is really important in the medieval period is the development of an iconography of animals and plants by sculptors and illuminators. We cannot talk about the origin of species correctly, though many people have of course tried, until we know what we mean by species. The sculptors who correctly distinguished, in

the Chapterhouse at Southwell, between the two British oaks were laying the foundation of this knowledge. Somewhat later, illuminators often introduced plants, insects, and birds into the decorative borders of manuscripts. The most astonishing of such decorations, full of insects, spiders, and shells, with a quite recognizable carpet beetle, have been studied by Dr. A. C. Crombie of Oxford. They date from the fourteenth century and are ascribed to Cybo d'Hyères, a Genoese who seems to have worked in Provence, in a region which was doubtless somewhat more influenced by Gothic natural iconography than was much of Italy. There are numerous later examples; a particularly lovely one, a late fifteenth century "Book of Hours," whose most recent owner was Yale's great benefactor Mr. Louis Rabinowitz, is waiting in the Rare Book Room of the Sterling Library for a donor. In this exquisite work, supposedly of Flemish origin, the flowers and fruits, which doubtless kept still, are all naturalistic; the birds, which did not, are mainly the types that later turn up on painted china or lacquered screens, though a hoopoe, a goldfinch, and a great-tit are clearly recognizable. The butterflies, of intermediate activity, are mostly fairly realistic, although the artist responsible had some ideas of his own. He depicted a clouded yellow (*Colias croceus*), the European ally of our sulphur butterfly, on several pages, a wall butterfly (*Pararge megera*) on pages 44 and 96, and apparently an Apollo butterfly (*Parnassius apollo*) on page 108; but there are also some strangely intermediate forms and at least one blue and yellow species whose habitat can only have been the artist's imagination.

Within a hundred years of this work, we have clear evidence that several people were collecting plants and animals, writing about them, drawing them, even attempting to publish about them. The second period in Western natural history had begun. The origin of such collections poses certain interesting problems on which too little research has been done.

The storage of dry drugs in comparably shaped but diversely labeled pots in an apothecary's shop gives some of the diversity in unity that satisfied a collector, as do the spices in neat boxes in a kitchen. The great collecting craze of the Middle Ages was for relics. At least in countries touched by the Reformation, the collection of both works of art and later of natural curiosities may have taken the place of the vast accumulations of minute fragments of a whole army of saints, neatly labeled, authenticated, and stored in glazed ornamental containers. A further stimulus to collecting doubtless came from natural rarities such as narwhal's tusks, doing duty for unicorns' horns, and bezoar stones, which were collectors' items, as well as more or less magical drugs.

Sometime during the sixteenth century, the esthetic interest in organisms, the practical interest in drugs, the learned interest in the writings of the ancients that dealt with natural history, and the collectors' en-

thusiasm previously directed towards books, relics, and *objets d'art* must have united to produce the first systematic natural history collections. Gesner was making collections of plants before 1560, Samuel Quickelberg published a catalogue of his collections in 1565, there was a storehouse of natural rarities at the court of Saxony. William Penny, who died in 1588, had a "treasury of insects" and left a mass of manuscripts, which later were edited by Thomas Moffet as the "Theatrum Insectorum," from which the quotation with which I began is taken.

It is important to notice that, throughout the whole of the second or Renaissance period of natural history, which lasted from some time in the sixteenth century to 1859, there is always a strong religious motive for the study of natural history. "He that beholds the forms, clothing, elegancy and rich habits of the Butterflies, how can he choose but admire the bountiful God, who is the Author and giver of so rich treasure." In a like vein, Linnaeus believed that his "Systema Naturae" represented valid insight into the thoughts of the Creator. This attitude persisted so long as people believed that they were created to praise God.

The third or modern period of natural history has lasted just a century. It has been dominated by the idea of evolution, a scientific idea that has had a far more powerful effect on men's minds than has any of the physical sciences, however much they may have altered our physical environment. Evolution as we know it was born in the mind of Charles Darwin when collecting museum specimens. Much of the later development of the theory has been due to museum workers. A large part of the justification of any university museum lies in the contribution that can be made in it to this kind of knowledge. We need to know far more than we do. Discoveries of any sort in science can be applied to human affairs, but it is evident that in general one needs to know vastly more in order to make the applications wisely and constructively than is needed to do it foolishly and destructively. That is one cause of our present predicament. We are presumably still evolving; people make guesses that we are undergoing evolutionary loss of teeth, hair, or little toes. For most such guesses, there is not a particle of evidence. There is, however, much evidence to show that, for example, the peculiar characteristic of having a big toe shorter than the second toe, a character that apparently is slightly maladaptive, was regarded as esthetically ideal by the Greeks, and is known to be inherited, has spread through a large part of the population. No one knows why. We are full, body and mind, of such problems. In most cases, we can learn best about ourselves when guided by analogies from birds and fishes, butterflies, sea shells and sponges.

For the sake of humanity, as well as Yale, I hope, therefore, that the present addition to the Peabody Museum is not the last, as a vast collection is needed and many workers are required to solve the problems that

Fig. 1

Fig. 2

animals and plants, fossil and living, present in their diversity. Birds and fishes are now wonderfully housed; insects and some other invertebrate groups await their Maecenas.

There is yet another cause of our present discontent. The theory of evolution has often been applied unwisely, sometimes wickedly, to men's minds. A hundred years ago it became evident that each species was not made in Eden individually on the basis of some archetypal design kept in heaven. When such an over-simple idea was abandoned, the religious meaning for the study of natural history, with much of the wonder and glory, officially disappeared. I do not think that this fundamental attitude really disappeared from the mind of the investigator; a love of the created world, a sort of natural piety, exists in the minds of nearly all naturalists. What happened was that the attitude became something to be held in private, in an apologetic manner, something regarded in the public world as sentimental, impractical, or unrealistic. I believe very strongly that, whatever religious beliefs an investigator may or may not have, this point of view is an essential ingredient of good work, and in our human predicament can be a saving grace. It is one of the attitudes that can help us from destroying our natural heritage, which we are doing at an alarming and ever-increasing rate. I would remind you that, during nearly all the history of our species, man lived in association with large, often terrifying, but always exciting animals. Models of the sur-

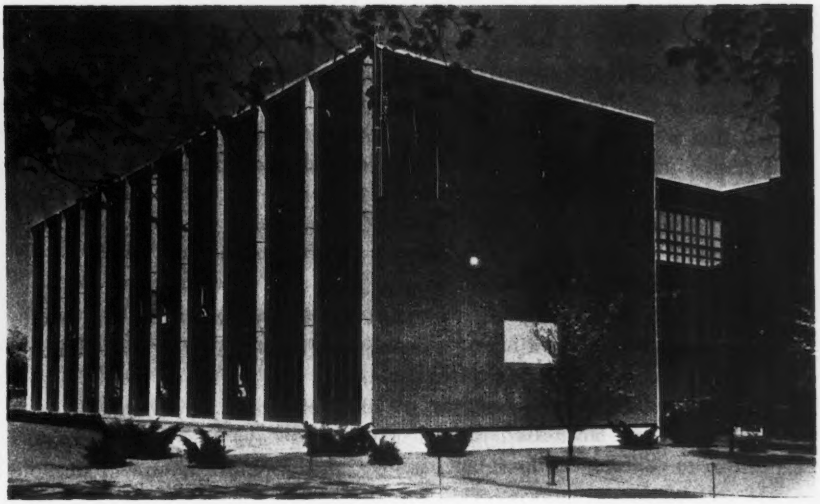


Fig. 3

vivors, toy elephants, giraffes, and pandas, are an integral part of contemporary childhood. If all these animals became extinct, as is quite possible, are we sure that some irreparable harm to our psychological development would not be done? In a broad context, are we certain that we can really persist as humane human beings in a world in which natural and much artificial beauty is being continually replaced by ugliness or at best by neutral functional forms?

A few weeks ago, I happened to be in the Coe Memorial room at the top of the new building where our enthusiastic ornithologists were arranging the collection of bird skins. Suddenly it dawned on me that I had never realized what an extraordinary number of pigeons are bright green. Most of you will also probably not have experienced any large number of green pigeons, though to the ornithologist they are a commonplace. Many of them have in addition minor decoration in a great variety

Fig. 1. The old Peabody Museum, located on Elm Street in New Haven, which was demolished in 1918.

Fig. 2. The new wing in combination with the present Peabody Museum building.

Fig. 3. The new wing, dedicated October 30, 1959.

of other colors, often of a rather startling kind. To me, this realization, though it had no apparent value in relation to anything else that I knew, gave me intense pleasure that I can still recall and re-experience. Feelings of this sort mold our lives, I think always enriching them. It is for the further opportunity for such experience that I would like to thank all who are responsible for the splendid addition that is being formally presented to the University today.

DANIEL MERRIMAN

It is, first of all, a pleasure to add my very warm welcome to you who are gathered here for the autumn convocation of the Alumni Board.

Perhaps, as well as anyone in this audience, I can understand the *distance* between "the playing fields of Eton" (a subject to which you have addressed yourself earlier this day) and oceanography. Distances, differences in subject matter, the disparate nature of disciplines—these things can be as wide, or as narrow, as the human mind chooses to make them. For years, Bob Kiphuth and I played squash together; let it be noted also that he received from me a copy of every scientific paper dealing with the motion of aquatic animals.

Similarly, the subject before you today, "The Role of the Museum in Teaching and Research at Yale," might, at first glance, seem inapposite to the field I represent—oceanography. On the contrary, I assure you.

Oceanography is the study of the oceans in all their aspects. How to date its inception as a science is purely academic in argument. Magellan tried to sound the Pacific with several hundred fathoms of line, and, failing to reach the bottom, he somewhat naively concluded he was over the deepest part of the ocean. Actually, though by no means over the great depths, Magellan missed by about 10,000 feet. Captain James Cook, on his 1768–1769 voyage of discovery to the South Pacific, took temperature observations and deep-sea soundings; some are inclined to call this the first true oceanographic expedition. And Benjamin Franklin published his map of the Gulf Stream in 1770. Actually, the birth of modern oceanography dates from December 12, 1872, when H.M.S. "Challenger" circumnavigated the world, traveled 69,000 miles, and occupied 362 stations at sea making detailed observations in the physical and biological sciences. (Parenthetically, may I call your attention to the exhibitions of books in the Sterling Memorial Library that mark today's occasion?)

So oceanography is a *modern* composite of sciences. Among its other aspects it involves the collection, study, and preservation of marine objects ranging from seaweed, plankton, and fish to cores of bottom sediments and meteorites. These collections have to be housed and catalogued for study and restudy. They belong in a museum of natural history,

both for exhibition and research. They are the source references for future generations of scientists.

Oceanography arrived at Yale and the Peabody Museum in 1930 when Harry Payne Bingham, 1910, gave the collections (most notably deep-sea fishes) he himself had made on private expeditions a half decade earlier. With these collections came a young Norwegian, Albert Eide Parr, of whom *The New Yorker* wrote when he was made Director of The American Museum of Natural History in New York in 1942, "In 1926 he came to this country to find wider opportunities. These opened up dimly at the [New York] Aquarium, where he got a job at $110 a month cleaning spittoons, feeding fish, and washing windows. . . . later Harry Payne Bingham put him in charge of the collection at New Haven."

The original statement of intent for the Bingham Laboratory was, quite simply, "Founded for the purpose of oceanographic research." Research is our primary business, and the published record amply bears us out. Teaching also bears us out. Our graduate students in course this year are from four different departments: Botany, Chemistry, Microbiology, and Zoology.

The past thirty years have seen a great burst of oceanographic activity in this country, though apparently far behind Russian endeavors in many respects. The science has both pure and applied connotations; examples of the latter are submarine warfare and petroleum resources. So it is that a National Academy of Sciences committee has recently recommended to Congress the expenditure of $651,000,000 over the next ten years to speed research in oceanography. With our expanded research and teaching capacities, and with the cooperation of related departments at Yale, I assure you we will more than keep pace.

What are the departments of science that relate to oceanography? They are chiefly biology, chemistry, and physics: we deal with the living things in the ocean, with the chemistry of sea water, and with the physical forces that control the motion of the fluid that covers over seventy per cent of our globe. Clearly, too, mathematics, meteorology, engineering, geography, and geology have an intimate relation with oceanography. As I indicated earlier, it is a composite of sciences—a composite that even includes medicine in our case, through the basic study of endocrinology in the lower vertebrates.

To speak for all our sciences, I think the Aristotelian quotation sums it best:

> *The search for truth is in one way hard and in another easy, for it is evident that no one can master it fully nor miss it fully. But each adds a little to our knowledge of nature, and from all the facts assembled there arises grandeur.*

KARL K. TUREKIAN

There are three major institutions, aside from the home, that are dedicated to the preservation and propagation of human learning: the library, the university, and the museum.

There is little question about the function of libraries; they are for the preservation of the written record of man's achievements (and follies).

The university is still fairly commonly acknowledged to be an institution in which the accumulated minds of scholars, mature and growing, interact, resulting presumably in the type of product that will help fill out the spaces in future library stacks.

Here we begin to see, however, the beginnings of confusion in the popular mind. The image of a university as the "homecoming" weekend and the varsity letter man, though latent in the public mind, is sufficiently strong to channel a significant fraction of their funds and interest to the heroes of the sports pages.

But perhaps the greatest popular misconception of this kind involves the museum, and particularly the natural history museum. Instead of the image of a treasure house of the Muses, it is commonly confused either with a somewhat out-of-date Disneyland or a glorified and expensive attic where the debris of past generations is deposited in relief if not in reverence. (You know: "This old jug that Grandfather loved so well. It's a shame to throw it away, but it obviously doesn't fit into the decor of our new Zen-Buddhist room. Can't we give it to a museum or something?—And of course this is the birth of many a provincial "museum," usually in a town that has been transformed from a place where the living was once hard into a tourist resort.)

Now this is not what a natural history museum really is, as your visit here today must have already demonstrated. Basically it is a place where the materials of the earth in all their manifestations, of animate and inanimate origin, indigenous and extra-terrestrial, are collected and catalogued by competent scholars while in pursuit of their own specialized fields of research. Their proximity to the heart of science, namely, research, makes them deliberate in their broad collecting and diligent in their cataloguing, aware that other scientists, particularly those of the future, will be dependent on these collections to implement research which often cannot even be conceived of at present.

To return to our comparisons of the library, university, and museum—it is obvious that these three institutions are so closely related in their purposes that at such a place as Yale they are, so to speak, under one management to the mutual benefit of all.

As a library may display on occasion its choice collections ultimately as a device to show what delicacies are available to the interested party in the stacks, and as a scholar may lecture seductively to woo the un-

committed mind to a richer area of thought and scholarship, so also a natural history museum displays some of its acquisitions as a sort of "come-on" to excite the imagination of the young and to inform colleagues of the extent of its treasures.

On display in Peabody Museum at Yale, for instance, is the first well-documented fossil evidence for the evolution of a living animal: the skeletons of ancient horses which successively inhabited North America. When Thomas H. Huxley arrived in America in 1876 to deliver the dedication address of the newly established Johns Hopkins University, his first stop was New Haven to talk with Professor Marsh and peruse his vast fossil collections.

The visit was not fruitless. Huxley completely revised the talks he was to give on the subject of mammalian evolution and wrote soon after his visit, ". . . no collection which has been hitherto formed approaches that made by Professor Marsh, in the completeness of the chain of evidence by which certain existing mammals are connected with their older Tertiary ancestry."

Many years later a Yale man, who during his undergraduate and graduate days was undoubtedly confronted daily by Professor Marsh's fossil bones, was to write fundamental treatises, not only on "Horses" but on "The Major Features of Evolution" and the "Meaning of Evolution." I speak, obviously, of Professor George Gaylord Simpson.

The museum's relation to the public is to some extent symbiotic. The museum staff, in the pursuit of scholarship, may be aided by the discoveries of amateurs who bring specimens which they have found in their backyards or during more extensive tours. Though they are usually common materials already well described, sometimes a new discovery is made this way.

Secondly, a private collector of specimens, after a life of enjoyment in exploring some of the more difficult or esoteric aspects of the natural world, may wish to donate his collection to an organization that will use the materials to best scientific advantage, and of course the museum is the logical place to come.

Finally, wealthy, and sometimes not so wealthy, donors may make important accessions possible by their gifts. Of interest is the cornerstone of the mineral collection in the Peabody Museum which was paid for, in the early nineteenth century, by interested inhabitants of New Haven who contributed their pennies and dollars so that Yale might have the fine collection of Colonel Gibbs.

So, as the museum may inspire the public, the public in return may make such inspiration possible.

But this is not the main purpose of my talk today. What I really would like to focus attention on is what I call the unpredictable uses of a

museum. I think I can best explain this by using an example which may make some of you wince.

When Professor W. F. Libby postulated the continuous generation of radioactive hydrogen in our atmosphere by cosmic rays, he sought to test the validity of certain assumptions regarding the rate of production and the ultimate fate of this radioactive isotope. For this he needed many samples of accurately dated hydrogen younger than 50 years. One obvious source would have been water, but rarely does one preserve accurately dated bottles of water, and there are other difficulties besides. One substance, however, did fulfill all the requirements required for these measurements—wine. If one could go to a reputable vineyard and collect several gallons of vintage wines of carefully selected ages, such a collection would satisfy the conditions of the experiment precisely. So several gallons of different vintage wines from a common vineyard were distilled and electrolyzed and the radioactivity was measured. The results confirmed Dr. Libby's hypothesis.

The point of this story is that sometimes materials may be used for experiments for which no plans could be made. The wine maker diligently recorded the vintage year of each annual crop to maintain his honor among gourmets rather than to provide Dr. Libby with samples for his radioactive measurements, yet the very care involved in his collecting and cataloguing made the samples of inestimable value to science.

This is perhaps a poor analogy to the work of the museum. There is one thread in the analogy, however, that I would like to keep in showing how museums have been the source of materials, the use of which the collector could hardly have imagined—the term "cosmic rays." Indeed I had thought of changing the title of this talk to "Cosmic Rays and Museums," but this sounded too much like a "Science and You" type of topic, with all the frightening thoughts of pedantry *that* conjures up.

If there are any two subjects that are of major world-wide interest today they are certainly the subjects of space flight and radioactive fallout, and just precisely to these topics can some of the materials of a museum contribute!

As I have noted before, when cosmic rays interact with matter, being of very great energies, they produce a variety of new atomic species, all of them at some time radioactive. Because radioactivity has in itself the properties of a clock, we can use this induced radioactivity in several ways.

Meteorites, for instance—those travelers through interplanetary space—record the effects of their journey, most of which has been in orbit around the sun through the cosmic ray field that shrouds our solar system. One measure of this so-called flux of cosmic rays, as recorded by meteorites, requires an accurate dating of the day of fall of the meteorite. Museums have such collections, and records of this type of information are care-

fully catalogued when available.

For instance, the first meteorite seen to fall by white men in the New World and collected and preserved is the one that fell in Weston, Connecticut, in 1807. We have it in the Peabody Museum because Benjamin Silliman could sense the value of this material. Hardly could he have imagined, however, that meteorites might some day be used for estimating the deadly, high-energy, cosmic-ray flux of space from which we must protect any astronauts who flutter about in outer space.

Cosmic rays not only make wines radioactive and meteorites estimators of cosmic-ray flux, but also aid us in the dating of archeological and geological artifacts and events through the use of radioactive carbon 14. But I wish to talk not about this aspect of carbon 14 but of the more imminent one of the effects of radioactive fallout. I offer no judgments of any sort on radioactive fallout, either biological or moral. My purpose is to talk about what museums have to do with it all.

The ratio of radioactive carbon to so-called "dead" carbon in any carbonaceous material is simply a function of the ratio of these two isotopic species in the atmosphere and oceans. Dr. Linus Pauling and others have brought to our attention the fact that the carbon 14 of the atmosphere has increased markedly as the result of the recent production of all sorts of radioactive species by atomic and hydrogen blasts. The amount of new radioactive carbon can be calculated, and it has been measured in sea shells and other materials collected at fixed times after the last major blasts. If this were the only event our atmosphere has experienced in varying the radioactive carbon to dead carbon ratio, the equation would be elementary, and all arguments could be transferred to the moral and biological realm.

However, the story is not that simple. Before the advent of this new source of radioactive carbon 14, it was observed by Dr. Hans Suess that after a correction for the inevitable radioactive decay of carbon 14, trees and shells of the nineteenth century were considerably higher in radioactive carbon than those just before the atomic blasts. The types of materials that had to be used for such a study were those with a careful date of acquisition. The collections of Florida shells made by the late Professor Lull's grandfather in 1822, or the 1866 collection of Central American sea shells made by Bradley, both at the Peabody Museum, would have suited this study admirably.

Indeed, by looking at these carbon-bearing materials, we see that since about 1890 the ratio of the atmospheric radioactive carbon 14 to dead carbon has been diminished by the dilution of carbon dioxide from the burning of fossil fuels such as coal and oil which, because of their great age, no longer contain radioactive carbon. As a matter of fact, Drs. Kulp and Broecker of Columbia University have calculated that the bombs will

have brought the ratio of radioactive to dead carbon back to just about pre-1890 levels once equilibration of the oceans and atmospheres is established!

Neither sea shells nor meteorites were collected for the purposes for which they have recently been used, simply because these uses could not have been imagined at a time when radioactivity had not even been dreamed of. This, then, is the story of a museum—a place where prophetic scholarly minds, while in the pursuit of their own research, preserve for posterity the stuff from which future research and inspiration come.

Theodore Roosevelt Park: 1807–1958

The area in New York City bounded by Seventy-seventh Street, Columbus Avenue, Eighty-first Street, and Central Park West has been the site of The American Museum of Natural History since 1872, when the Commissioners of the Central Park offered the land to its first Board of Trustees, among whom was Theodore Roosevelt, father of the twenty-sixth President of the United States.

For one hundred and fifty years this land had been known as Manhattan Square, but on March 11, 1958, with the approval of the Mayor and by enactment of the City Council, Manhattan Square became Theodore Roosevelt Park, in celebration of the Theodore Roosevelt Centennial, and in honor of three generations of Roosevelts who have served as Trustees of The American Museum of Natural History.

Over the years the face of the park has greatly changed, owing in large part to the growth and development of the Museum. To acquaint its visitors with the changes that have taken place, The American Museum of Natural History held, in 1958 and 1959, an exhibition entitled "Theodore Roosevelt Park." The photographs and text that follow are from that exhibit, which was prepared by Miss Katharine Beneker, and designed by the Exhibition Department of The American Museum.

Fig. 1

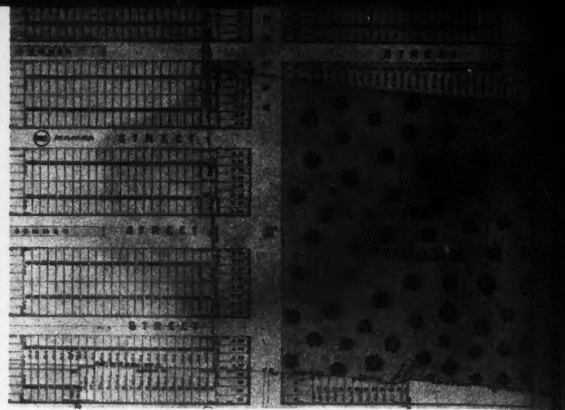


Fig. 2

A PARK IS SURVEYED

By the early 1800's New York City was still confined to that part of Manhattan Island below Canal Street. To the north lay farms, estates, and occasional hamlets such as Harlem, Claremont, and Bloomingdale. But the city was growing, and on April 3, 1807, a law was passed appointing Simeon DeWitt, Gouverneur Morris, and John Rutherfurd to lay out the whole island of Manhattan in streets and avenues "by careful survey." As a result, Manhattan Square was established in its present location almost fifty years before there was thought of a central park.

Nine-tenths of the land selected for the square belonged to David Wagstaff, who had purchased "39 acres, 3 rods, 12 perches" from Rebecca Apthorp for $5,476 the previous year. Miss Apthorp had inherited the land from Charles Ward Apthorp, whose mansion was near the corner of what is now Ninety-first Street and Columbus Avenue in the hamlet of Bloomingdale. In 1832 the city actually purchased that portion of the Wagstaff estate included in Manhattan Square and valued at $39,292. Eighteen years later all the land had been acquired, the total being $54,657.

EIGHTEEN ACRES OF ROCK

In spite of the rolling hills pictured in Martel's drawing of Central Park, Manhattan Square was eighteen and one-third acres of rocks, stagnant pools, and goat hills. To Professor Albert Bickmore, founder of the Museum, it was a discouraging sight. "Within the boundaries of our area the prospect was most desolate and forbidding. There was a high hill at the north east corner, of which a remnant still remains in the park between Eighty-first and Eighty-second Streets; and in the north west corner another hill of solid rock rose much higher than the elevated railroad station, which now stands in its place. In the southern and central part of the square, just where the first section of our building was to be erected, was a third hill, whose crest rose as high as the ceiling of our present Hall of Birds. As I sat on the top of this rock, the surrounding view was dreary and my only companions were scores of goats."

Fig. 3

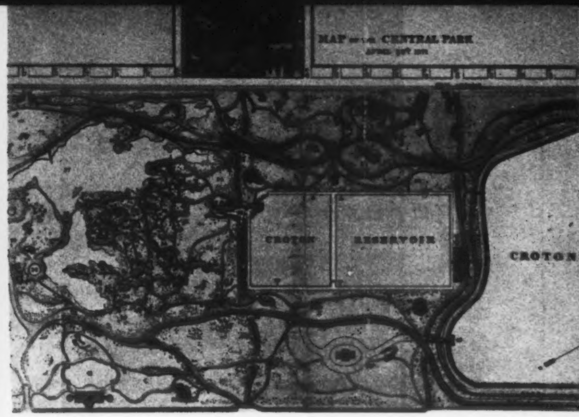


Fig. 4

Fig. 5

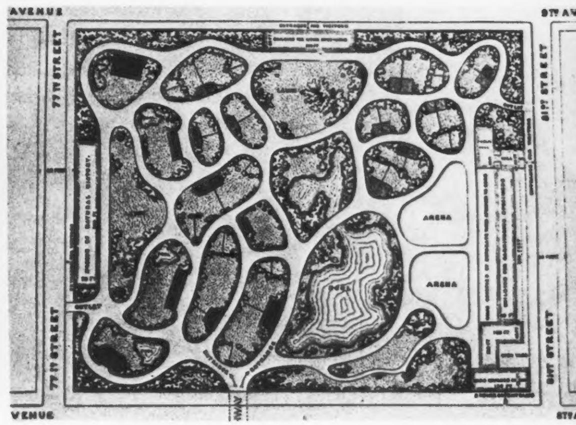


Fig. 6

Fig. 1. Map showing the "laying out of streets and roads in the City of New York" as provided by an Act of April 3, 1807, and completed on March 22, 1811.

Fig. 2. Map of portion of Manhattan Square owned by David Wagstaff.

Fig. 3. Bird's-eye view of Central Park as seen from Fifth Avenue and Fifty-ninth Street by Martel and Geissler in 1864, showing the unpopulated area west of the park where Manhattan Square was located.

Fig. 4. Map of a portion of the Central Park, including Manhattan Square, since 1864 called Central Park. Number 43 is a "Proposed Art Museum and Hall."

Fig. 5. Topographical map of Manhattan Square. "The entire surface is extremely uneven and broken, and varies in elevation from fifty-two feet to one hundred and four feet above high water."

Fig. 6. According to an Act passed in 1864, the Commissioners of the Central Park were to establish a botanical and zoological garden in the Central Park. Manhattan Square, now part of the Central Park, was selected, but it was found to be too expensive to adapt the area for such a proposal.

THE ENVIRONMENT

In 1703 Bloomingdale Road (now Broadway) had been extended from Madison Square to Claremont (now One Hundred and Fourteenth Street), and somewhere along this road lay the hamlet of Bloomingdale, once known by the Dutch as Bloemendael, meaning "Vale of Flowers." In 1867 it was still a country village, but a few years later, Irish immigrants had settled as squatters on its outskirts.

Professor Bickmore remembered that in 1872 "only the temporary shanties of squatters could be seen on the north, except two or three small and cheap houses half way between Eighth and Ninth Avenues. On the west were only shanties perched on the rough rocks, and south of us there was no building near." Someone else recalled that "from Fifty-ninth to Sixty-fourth Street there was a row of squalid shanties, beer saloons, and about were hills and outcroppings of rock which were gradually being blasted away. All the land thereabout was made and had to be filled in with rock blasted from the goat hills. The west side was considered most undesirable, and desperate efforts were being made to make it popular." The once beautiful Apthorp mansion now housed a beer and dance saloon known as Elm Park.

Fig. 7. Pen and ink drawing of the village of Bloomingdale made by Eliza Greatorex in 1867.

Fig. 8. George Hayward's drawing, dated October, 1861, showing the junction of Bloomingdale Road and Eighth Avenue, with the village of Bloomingdale in the distance.

Fig. 9. Panoramic view of the area south of Seventy-seventh Street in 1878. Columbus Avenue is on the right and the Hudson River in the background.

Fig. 7

Fig. 8

Fig. 9

A SITE FOR A MUSEUM

Nevertheless, when the Commissioner of the Central Park (under whose jurisdiction Manhattan Square had been placed in 1864) offered the site to the Board of Trustees of The American Museum of Natural History, it was accepted, and on December 22, 1877, the first section of an impressive plan designed by Mr. Calvert Vaux was opened.

"As we wished to firmly locate our institution upon Manhattan Square at the very beginning and also to show from the first that our future edifice was ultimately to occupy its entire area, we decided to use our first appropriation in erecting one of the interior parts of the general scheme, and, therefore, we chose the wing radiating from the central tower or dome to the middle of the southern side as the first to be built, realizing that both of its walls must in time become only walls of interior courts . . . the expense of cutting down the high hill of rock . . . , and of grading the surrounding area, proved to be so great, that we were obliged to defer using the selected red granite until we should begin to erect the exterior of the whole structure." When finished it stood tall and bleak and unattractive amid the rocks and pools of the surrounding area.

Fig. 10

Fig. 11

Fig. 12

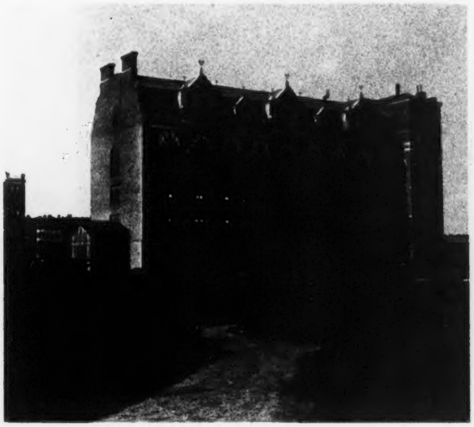


Fig. 13

Fig. 14

Fig. 10. Proposed elevation of The American Museum of Natural History.

Fig. 11. The Museum as it appeared in 1878, shortly after it had opened.

Fig. 12. Draining Manhattan Square in 1880. A stream ran from a little pond in the square to the large lake in Central Park, then down to the East River.

Fig. 13. "By 1882 all of the filling had been brought in and the surface of the borders and the southern half had been planted."

Fig. 14. The lone building of The American Museum of Natural History as seen in 1885 across Central Park from the Lenox Farm on the corner of what is now Madison Avenue and Seventy-first Street.

Fig. 15

Fig. 16

TO THE EAST, TO THE WEST, TO THE NORTH

Although the opening of the Manhattan Elevated Railway in 1879 with a depot on the corner of Ninth Avenue and Eighty-first Street had made Manhattan Square and its environs more accessible, squatters' huts, undeveloped lots, and poor roads still persisted even as late as 1887.

Fig. 15. View from Manhattan Square looking east across Central Park.

Fig. 16. As late as 1893, this squatter's hut was located on the corner of Columbus Avenue and Eightieth Street. The Manhattan Elevated Railway and the Museum are in the distance.

Fig. 17. Looking north from the roof of the Dakota apartment house, built in 1881 and located on the corner of Seventy-second Street and Eighth Avenue.

Fig. 17

THE MUSEUM BEGINS TO GROW

Under the presidency of Morris K. Jesup, the work of the Museum—"to gather and display material; encourage individual research and study along special lines; publish the results of such study; provide lecture courses; conduct class work and prosecute field work"—developed so rapidly that more space was needed by the Museum. Messrs. J. C. Cady and Company were asked to prepare plans for a new building. These were accepted, and the building was constructed and, on November 2, 1892, turned over to the Trustees by the city. It contained three large exhibition halls, six smaller ones, a lecture room (the present Seventy-seventh Street foyer), and a library.

Fig. 18. Rendering of the new design for the Museum as proposed by Messrs. J. C. Cady and Company. "Plans for the said structure are now being carefully considered, and it is hoped that during this year the foundation will be laid for the new building."

Fig. 19. The new wing as it appeared after completion in 1890.

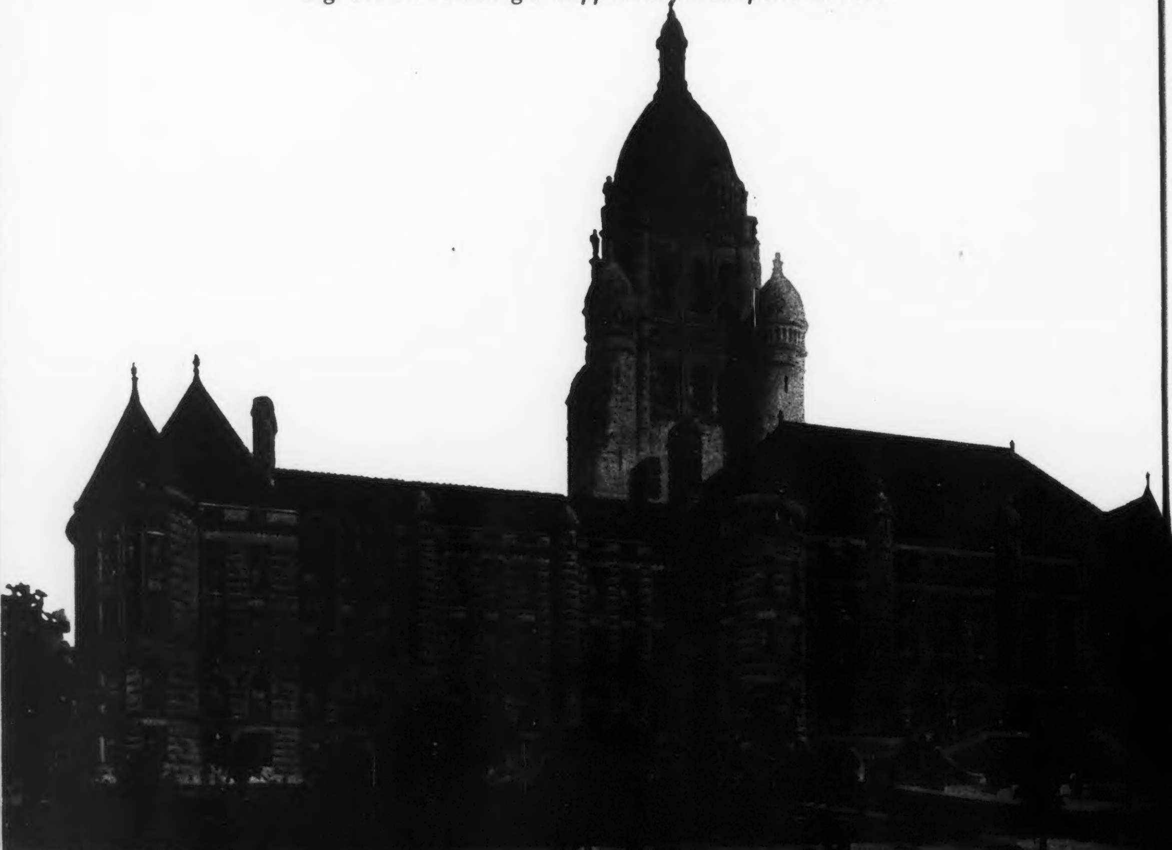


Fig. 19

Fig. 18

Fig. 20

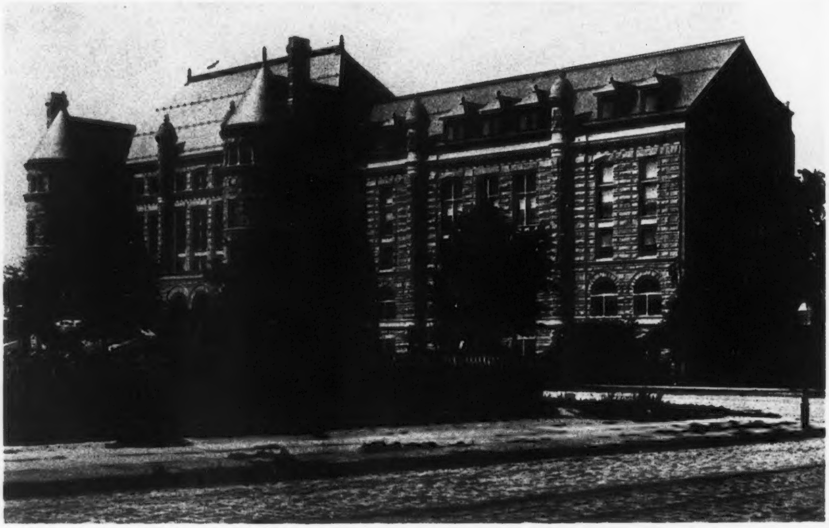


Fig. 21

Fig. 22

AND CONTINUES TO GROW

No sooner was the second building opened than the need was great for more room, and in 1894 the east wing was started. It closely followed the architect's plan for the whole south façade. "The building, from cellar to roof, comprises six stories, exclusive of the attic, and is 127 feet in height, with a frontage on Seventy-seventh Street of 157 feet, and a width of 66 feet . . . the building throughout is absolutely fireproof, the floors being finished in tile and marble mosaic of bright and attractive patterns."

This addition still left plenty of room for the neighborhood children, who used the north end of the square for snowball fights and sliding.

TURN OF THE CENTURY

In spite of the rapid increase in the cost of labor and iron construction, the south façade, running the entire length of the block between Eighth Avenue and Columbus Avenue, was completed in 1899. To quote *Harper's Weekly*, it presented "a picture rarely seen in our great cities—a building of great extent in which color, form and nature have been carefully considered for a harmonizing result."

The city was entering its most active era of expansion, yet Eighth Avenue still remained virtually undeveloped.

Fig. 20. North side of the east wing in the process of construction in 1894.

Fig. 21. South side of the east wing as it appeared upon completion in 1895. Note the empty lot on the corner where The New-York Historical Society now stands.

Fig. 22. In June, 1900, the south façade of the Museum was completed.

Fig. 23. Manhattan Square in winter.

Fig. 23

Fig. 24

Fig. 25

Fig. 26

ENCROACHMENT BEGINS

New York was expanding in all directions—upward and outward. Only at the northern limits of Manhattan was anything left of the island's original wooded charm. In like manner, the Museum was expanding northward into Manhattan Square. Another wing, running at right angles to the south façade and parallel to Columbus Avenue, was completed in June of 1908. Because work remained to be done in the way of decorating and casing before permanent exhibits could be installed, the building was given over to an International Tuberculosis Congress from November, 1908, to January, 1909. The *Annual Report* of the Museum for that year reads: "This exhibit occupied five of our large halls, and was a most complete exposition of the methods of checking the great white plague. The widespread interest in this exhibit was phenomenal. The total attendance for the seven weeks was 753,954 and the largest attendance in any one day was 63,256."

Fig. 24. Aerial view of The American Museum of Natural History as it appeared between 1908 and 1922.

Fig. 25. Looking south from the corner of Columbus Avenue and Eighty-first Street, showing the north side of the west wing and entrance to the tuberculosis exhibit.

Fig. 26. Looking north from the corner of Columbus Avenue and Seventy-seventh Street, showing the completed west wing on the left.

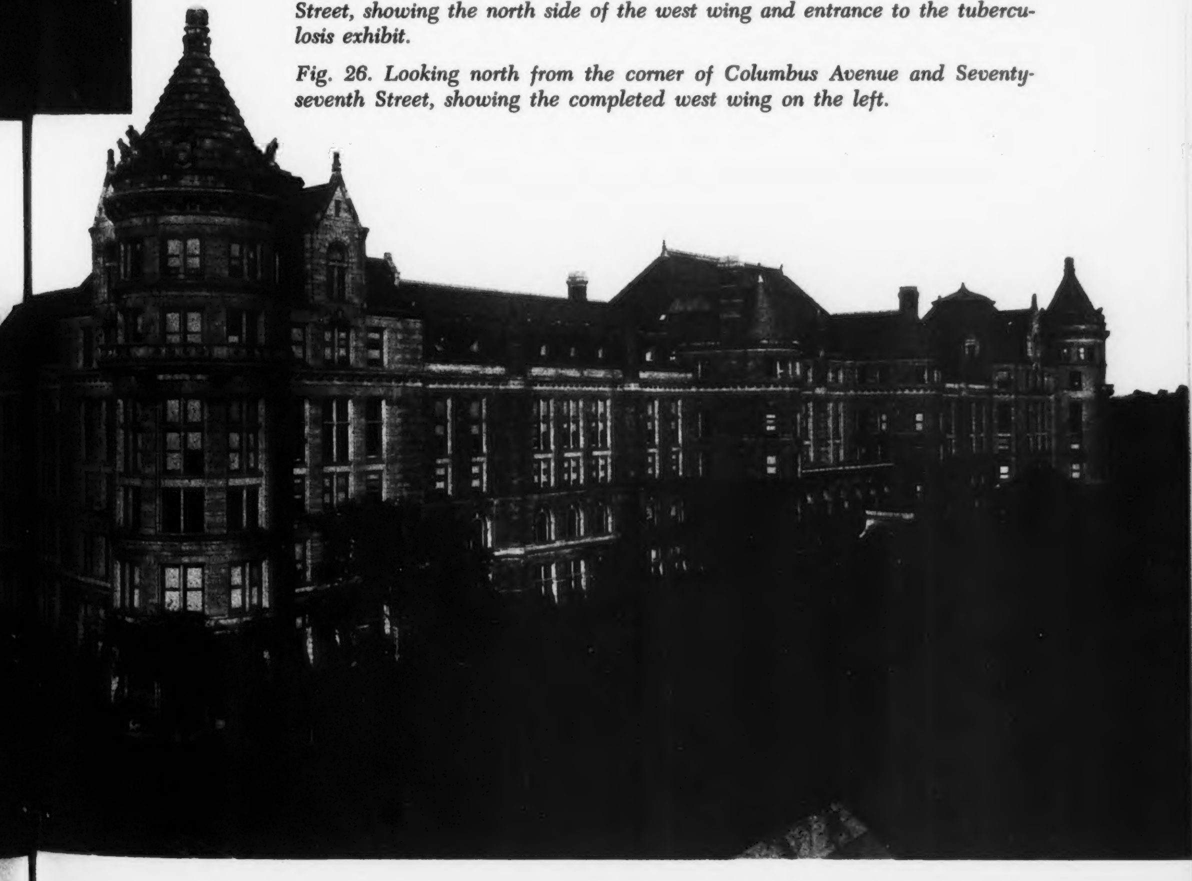


Fig. 27

Fig. 27. The east wing as seen from the north, with the Hall of Ocean Life behind it. Both of these buildings were completed in 1924.

Fig. 28. View from the corner of Central Park West and Seventy-seventh Street, showing the addition of the east wing.

Fig. 29. Aerial view of Manhattan Square and The American Museum of Natural History as it appeared in 1926. Note the construction for the Eighth Avenue Subway on Central Park West.

Fig. 28

THE PARK GROWS SMALLER

From 1908 until 1922 Manhattan Square remained unchanged. But plans and more plans were being developed, including a wing along the east side of the square and at right angles to the south façade, and which was said to "retain the main lines of the south façade but is a marked step in the direction of greater simplicity of design." As early as 1911 the Board of Estimate and Apportionment appropriated $200,000 for the excavation and foundation, but the financial condition of the city worsened, and all building was stopped. For ten years a yawning hole marred the beauty of the square. Finally in 1924, the southeast wing and the Whale Court, or Hall of Ocean Life, were finished, the latter being described somewhat fulsomely as "the most complete and beautiful museum unit in the world."

Soon after, work was commenced on another inner court building to be used for the school services. In this structure the break with the original architectural style of the Museum was complete.

Fig. 29

Fig. 30

Fig. 31

Fig. 30. Looking north from the corner of Central Park West and Seventy-seventh Street in 1937.

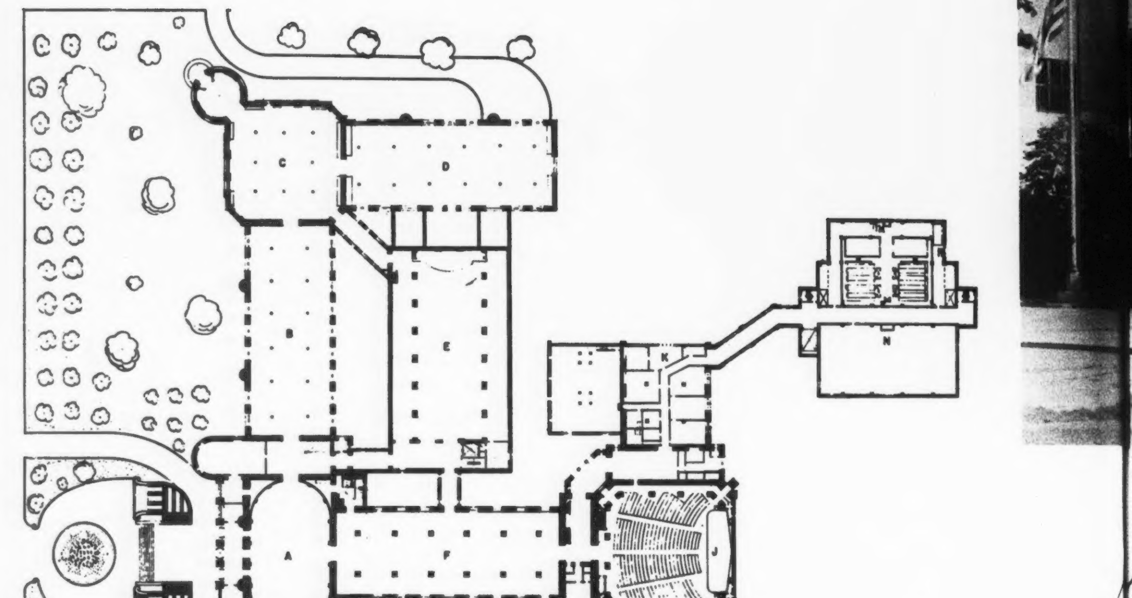
Fig. 31. The Theodore Roosevelt Memorial.

Fig. 32. Aerial view of Manhattan Square and The American Museum of Natural History in 1937.

Fig. 32

THEODORE ROOSEVELT MEMORIAL

Starting in 1932, three buildings were added on the east side of the square, the most impressive of which was the Theodore Roosevelt Memorial, long a dream of Henry Fairfield Osborn, President of the Museum from 1908 to 1932. When in 1920 the Legislature of New York State conceived the idea of a Theodore Roosevelt Memorial, Professor Osborn persuaded the Legislature that the memorial should form the Central Park entrance to The American Museum of Natural History. The cornerstone was laid in October, 1931, by the Governor of New York, Franklin D. Roosevelt (a distant cousin of Theodore's), and the building was dedicated by him, as President of the United States, in January, 1936. The other two buildings were the African and Whitney wings, adjoining the Roosevelt Memorial building.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SUBWAY
CENTRAL PARK WEST

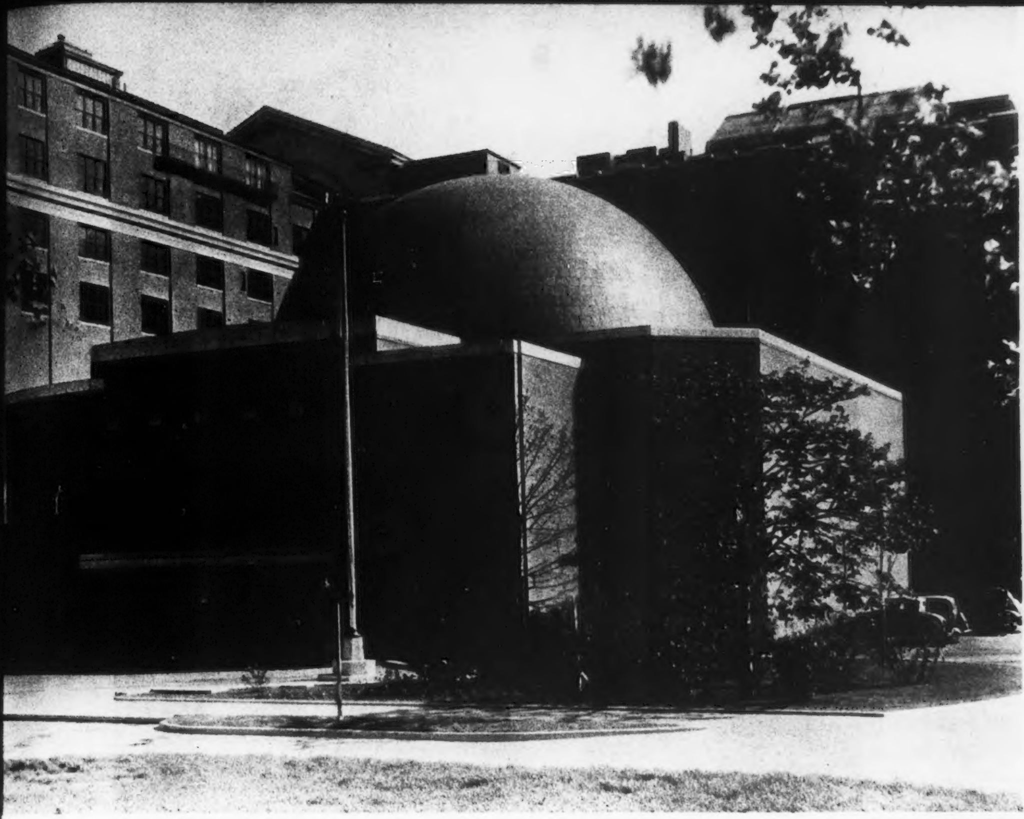
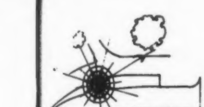


Fig. 33



A PLANETARIUM IS ADDED

A planetarium, or astronomy hall, to be located in the tower and even as late as 1925 planned for the center of the square, had always been an important part of the over-all plan for The American Museum of Natural History. When, in 1932, Mr. Charles Hayden offered the Trustees a Zeiss projector and a Copernican planetarium, and the Reconstruction Finance Corporation agreed to provide the housing for them, it seemed best to construct a separate building behind the Whitney and African wings, facing north, with an entrance on Eighty-first Street. Thus, on October 3, 1935, The Hayden Planetarium was opened to the public, and within a few months more than 300,000 persons attended the demonstrations by the Zeiss projector.

Fig. 33. The Eighty-first Street entrance of The Hayden Planetarium, now The American Museum-Hayden Planetarium.

STILL A PARK

The drastic relandscaping of the northern end of Manhattan Square, which the building of the Planetarium necessitated, was the last. There have been no children sliding down the snowy slopes of the square for nearly twenty-five years. Instead, they walk along the shaded paths which wind through Theodore Roosevelt Park—smaller than the original eighteen acres but still a park.

Children's Museums: A Definition and a Credo

HELEN V. FISHER, DIRECTOR
BROOKLYN CHILDREN'S MUSEUM

Those of us working in children's museums do not, of course, need any definition of that term; it seems quite obvious to us that it means a museum *for* children. But some people in the more conventional types of museums apparently have only vague notions about this "stepchild" of the field. I came across a case in point recently in a report of the International Council of Museums, the French version of which referred to the " 'Children's Museum' de Brooklyn," and the quotation marks must reflect the author's uncertainty about the title. This admittedly anomalous term leads the humorists to ask if we display dismembered children in our halls as an art museum displays sculptured torsos.

Possibly the confusion arises out of our use of the word "museum," which implies that we are entirely comparable to the other kinds of museums. Questionnaires intended to be adaptable to museums in general always include sections that have no relationship to a museum for children; they simply do not apply to our activities. A children's museum does, however, *look* like a standard museum. With its collections and exhibit galleries, it is certainly similar in physical appearance. But from that point we take off on a tangent, because the basic purpose of a children's museum is quite different from that of an "adult" museum. An art or natural history museum has as its prime function the preservation of the rare great creations of man or the compilation of sample categories of nature and societies. To these responsibilities has lately been added the interpreting of the collections to the general public. "Interpretation" really means "education," and in this sense most museums today are educators to some degree.

In children's museums the emphasis is very definitely on interpretation; our prime function is education. For this reason, our collections are not

necessarily gathered for their intrinsic worth or rarity. Our aim is not to be a storehouse for precious objects, but to collect materials that will be of use to us in interpreting various subjects and conveying ideas to children in graphic form. For instance, we might be fortunate enough to acquire something on the order of Bell's original telephone, but its greatest value for us would be its use in illustrating the development of communication, with less fanfare attached to its historic connotations. Our doll collection at the Brooklyn Children's Museum does include many unique examples, but these dolls are used not as an end in themselves but to show aspects of other cultures. Actually, our visitors and their response to the exhibits are more important than the collections themselves. By that standard, one might say that this *is* a museum of children as well as for them.

In any event, a children's museum is not a "miniature adult museum," nor a junior version of one. The divergent purposes mean that the two types should not be weighed on the same scales. An adult museum is a very serious matter. The value and importance of its collections make it incumbent upon its staff to do more than house the objects; they must utilize these materials to add to the body of knowledge through original research, which is a grave responsibility. A children's museum has, on the other hand, the responsibility of translating knowledge into terms of significance for the child and of justifying his dependence on the adult world. In this era of increasing leisure time, making possible more indirect education, museums can assume a major role in helping this country to raise its general cultural standards. While the adult museums seek to enrich the lives of adults (and children, too, in many cases), the children's museums can direct the child's interests, even into future productive fields.

The point I wish to stress is that children's museums and their work should not be judged according to the criteria of an adult museum, nor should a children's museum try to imitate the adult museums. "To each his own."

II

A museum for children is an institution of education. One might almost say that it is a hybrid between a museum and a school. I believe that most of these museums devote their major efforts to work with the local schools, making arrangements for classes to visit the museum in co-ordination with subjects that are being studied in the classroom in order that they may see related exhibits or collections. The value of visual aids is indisputable. Only the ultimate in imagination, coupled with the most effective verbal descriptions, can substitute for simply looking at an object and seeing a demonstration of its use. (The helpfulness of visual

aids is not limited to children. I have often thought that, if I could see in a model how my car engine operates, I would have a much better idea of which of its strange noises I should worry about.) Our collections are, then, visual aids. We perform a service to the school boards by bringing together in one place many, many objects that could not be duplicated nor housed in every classroom or even in every school. When a class that is studying, let us say, the period of westward expansion in American history comes to a children's museum, the visitors are shown (and often allowed to examine at first hand) a sampling of the kinds of things the pioneers took with them in their Conestoga wagons. Seeing these crude objects helps the children to understand the hardships of that westward journey.

Just making our collections available to the teachers is quite a full task, but it would be a pity to stop there when so much more can be done with so little additional effort. It is a question of deriving the fullest potential out of the collections. As the adult museums can use their collections for research, so can a children's museum use its collections as a springboard for getting children to consider the significance of what they are learning. While we show them the freight of a covered wagon, we ask them *why* the pioneers had to leave the harpsichords behind to make room for more water casks and ammunition. By our prompting the children to draw upon what they already know to figure out for themselves the reasons in answer to a curator's questions about the things they are being shown, they can, in a sense, visualize reasons as well as objects. "Why" is perhaps the key word in our form of education. Although the most difficult to answer of all questions, "why?" is the one of most interest to a child. It takes some ingenuity to explain to him why it is that, for some questions, only God knows why.

We see before us the normal healthy child's insatiable curiosity about the world around him, and it is his eagerness to learn that provides the children's museum with its *raison d'être*. The fact that the child must go to school (and offer some reasonable excuse to his parents if he fails to measure up well in the competition for good grades) may somewhat cool his ardor for knowledge. But a children's museum has the "cream" of education; we are not obliged to din facts into the child's head, but can show him those visual aids, let him hold a "real museum object" in his hands, and encourage his questions and his interest. I am perhaps reactionary in the belief that each child should be given the basic tools for his future, that is, factual information. It is all very well to encourage "creativity," but how can we allow a child to think he can conquer space until he has conquered mathematics! It is the job of the schools to provide what amounts to a birthright of a solid background of information on which the child can draw in his adulthood. The museums can help

both the schools and the parents in their efforts to direct the child in his application of learning. Children certainly deserve accurate information from the museums, too, but our purpose should be to show the interrelationships of facts, rather than to impose the memorization of data. It is not for us to spend time with a school class pointing out the subtle differences between a Chellean and an Acheulean tool, but to impress upon that class the truly momentous importance of man's ingenuity in making use of a tool in the first place.

Educators in children's museums are really fortunate, for we can work in an atmosphere pleasurable both for the children and for ourselves. To become serious and weighty about our form of education would be to destroy its very purpose, which is to let children enjoy the learning process.

III

Let me go back to that point about training children to reason things out for themselves, to *think*, that is, to build knowledge by the assembling of factual information and the association of ideas. A children's museum usually has a conglomerate of collections, parts of which may be grouped together to illustrate different ideas. For instance, we might display objects from one period in history or by geographical area, or we might take one particular type of object from successive eras to show the development of that object. Thus, an exhibit on Eskimos, including a parka, kayak, harpoon, fat lamp, soapstone carvings, and similar objects, set up in a scene suggestive of the Arctic, can give children a sense of that exotic landscape and strenuous existence. In another exhibit, that same harpoon can become part of a survey of hunting implements, put together to illustrate man's progress in outsmarting animals. In either case, the value of a museum visit lies not simply in handling unfamiliar objects, but in seeing those objects in their proper context and understanding their place in the history of civilizations. This grouping and *use* of museum collections give them an added worth over and above mere visual

Fig. 1. A class visiting the Museum for a discussion on Africa. While the curator explains the collections and passes them around through the class, the children can get a more vivid impression of primitive life in Africa than they might from books. As a climax to the session, a few of the more daring volunteer to make "music" with the drums and samiset.

Fig. 2. At the end of the semester, children in the Microscope Club held an open house to show their parents and other children what they had learned about microscopy. Each student in the club had selected his own project to work on through the term.

Fig. 1

Fig. 2

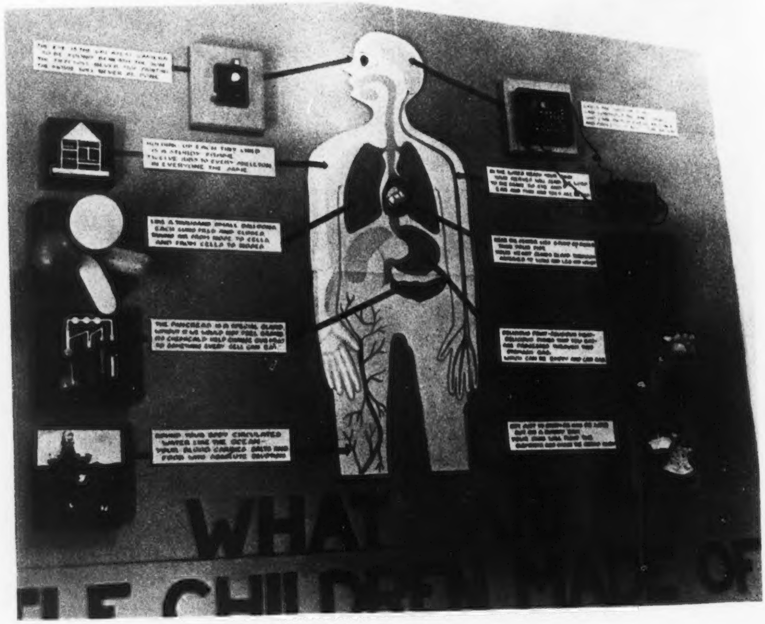


Fig. 3

Fig. 4

aids. The whole of the collections is greater than the sum of the parts.

It is this "tying together" of facts that is the particular contribution of a children's museum. The factor of having objects exhibited in one place, allowing children to see almost at a glance the contrasts and comparisons of different cultures, can give them a better understanding of a concept—a visualization of an idea—such as the influence of environment on style of architecture, the diffusion of cultures, or the necessities behind certain inventions and explorations.

Seeing these things in perspective can show children that there is something beyond memorization of dates and place names: that throughout history people have lived and acted according to their own philosophic and technological climate; that civilizations change as those climates develop; and that the United States of 1960 is not the ultimate of mankind, but only a further step in an ever-changing society. To teach children to evaluate the past according to its own standards (which is more easily done where museum materials can recreate the aura of the limitations in past ages) and not in comparison with the transitory present is, by extension, to train them to observe, analyze, and judge for themselves, and to accept change as an integral part of progress and of life itself. Intolerance, persecution, and stagnation come largely from a society's unwillingness to admit that it *might not* represent the final perfection of man. Humility and open-mindedness are needed in the coming generations to prepare them for the changes we now look forward to. Today's children are so used to rapid technological advances that there would seem to be no potential problem in their adapting to progress. Rather, it is hard for them to realize what a small percentage of man's history is the past half-century. When we in Brooklyn show a school class our model of an early New Amsterdam house and ask them to identify the things they see in the main room, they think they are going far back into the dim reaches of the past when they guess, as they invariably do, that the cuckoo clock is a wall telephone.

But, hopefully, our struggles today are directed towards something deeper than improved material existence. Are we not due for some more

Fig. 3. "What are Little Children Made of?" is a "teaching exhibit" in the narrowest sense of the word, that is, it is a diagrammatic exhibit without use of museum collections. Its purpose is to introduce to children some simplified physiology by the association of ideas—relating body functions to more familiar processes.

Fig. 4. A group of nineteenth century dolls is displayed at the Museum in a series of exhibits crowded with miniatures of the period. This deliberate clutter helps to convey the aura of the Victorian era.

fundamental changes than the colonization of Mars? What can we do to help children keep their inborn tolerance and thus be ready to accept changes in basic philosophy? As we cannot anticipate what the changes will be—nor even agree as to what they *should* be—all we can do is to train children to value knowledge and to use it intelligently, and to keep an open mind that will be receptive to new ideas as well as new methods. If the museums can use their collections in such a way as to teach objectivity, they can do much more than just add to the list of known facts.

IV

Museums for children usually have two main areas of activity: work with the many (school groups), and work with the few (clubs, field trips, and so on). It is the work with the few that gives us our greatest satisfactions. Club children, the museum "regulars" whom we get to know and whose progress we can watch, are the ones who provide measuring rods with which we can judge the success of our endeavors. (How can we know directly what a class has gotten from its visit to the museum when we may never see those children again?) Children's museums all over the country take pride in successful artists or scientists who "grew up" in that museum. And that is our golden aim: to start a child off on his future vocation. But there are intermediate goals too: avocations, hobbies, formation of study habits, utilization of one's own resources, to name a few.

Given the opportunity and congenial surroundings for pursuing his special curiosities, a child does not need to be driven to learn. (I hasten to reiterate that I feel he should be driven, if necessary, to learn to read and to count and to convey his thoughts with effective use of language.) After the substantial fare of school studies, he may come to the museums for dessert. Ice cream is full of nourishment; collecting minerals (or insects, or birds' eggs—whatever the club subject) can be filled with information and "study discipline." Children seem to be born with a propensity for collecting things—anything from the pebbles kicked home from school to postcards or bottle-caps or costume dolls. But humans of all sizes tend to lose interest in a project unless it is guided and can be directed towards completion. A children's museum can take the raw material of a child's "collecting instincts," his natural curiosity, and his love of *making* something and bring them together in constructive activity. We can help him put order and meaning into his collections so that he may in turn derive knowledge from them: arranging minerals to show kinds of structure, conditions of formation, and test types, or insects to show nature's camouflage, or studies of helpful and harmful insects, and so forth.

Museums for children provide many different types of materials for children to work with, from crayons and paper to wire and batteries.

There are opposing opinions as to what degree of relationship there should be between these activities and the content of the particular museum. Those of us who hold that a children's museum should educate, and not simply entertain, children will impose narrower limits of the use of materials. Unless in an art museum, clay will be used to make studies of dinosaurs or "Indian" pots modeled from the collections, not "free forms"; drawings will be made to study birds or mammals, or whatever, exhibited in the museum. It will be "factual" creativity.

"Collecting" and "creating" are only two of the many kinds of club activities in children's museums. Another, which might be called the "participating" clubs, would include astronomy, bird watching, or folk dancing (though this gets dangerously near the extraneous realm of "entertainment"—education can be rather broadly defined). There is an almost limitless range of club subjects, as limitless as children's interests. All combine several purposes into a fruitful end result: there is the actual learning a child derives from his club work, a sense of responsibility, training in scientific thinking—many things can be taught in this type of "painless education." On the more advanced levels, children can be given access to laboratory equipment not otherwise available to them. A research scientist needs to start his training as early in life as does a concert pianist.

In so far as practical, the club children work as individuals. Ideally, children with interests in common are brought together to pursue those interests, helping each other perhaps, but under no compulsion for all to make exactly the same thing. We hope in this way to put a premium on individuality, to do as much as we can to counteract the trend towards the conformity that is so deplored today. In Brooklyn, we do not make any effort to whip up extracurricular interests in the below-average child, because this generally entails lessened advantages for the above-average, thereby netting a sad level of mediocrity. This is not to say that only gifted children are welcome at our museum; it simply means that any child who has the spark of interest for a club is not below-average and is worth encouraging to become above-average.

A children's museum has a more direct relationship with its visitors than does an adult museum, and we have a proportionately larger influence in their lives. This is what we mean when we begin to talk, as we all do sooner or later, about our responsibility to the future.

PICTURE CREDITS

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